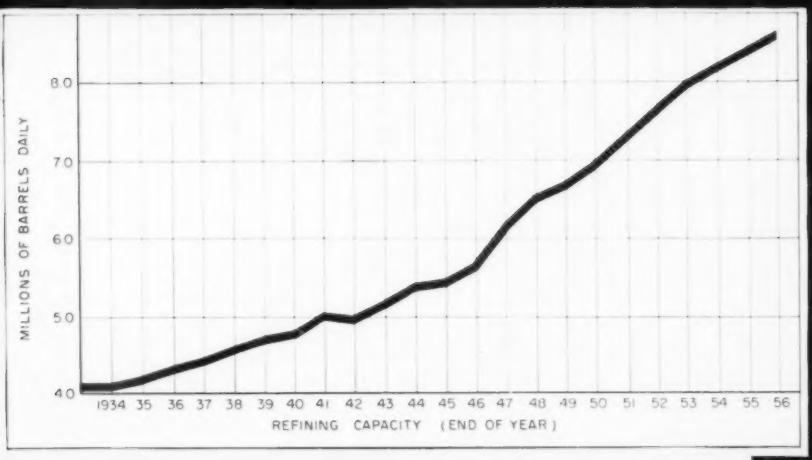
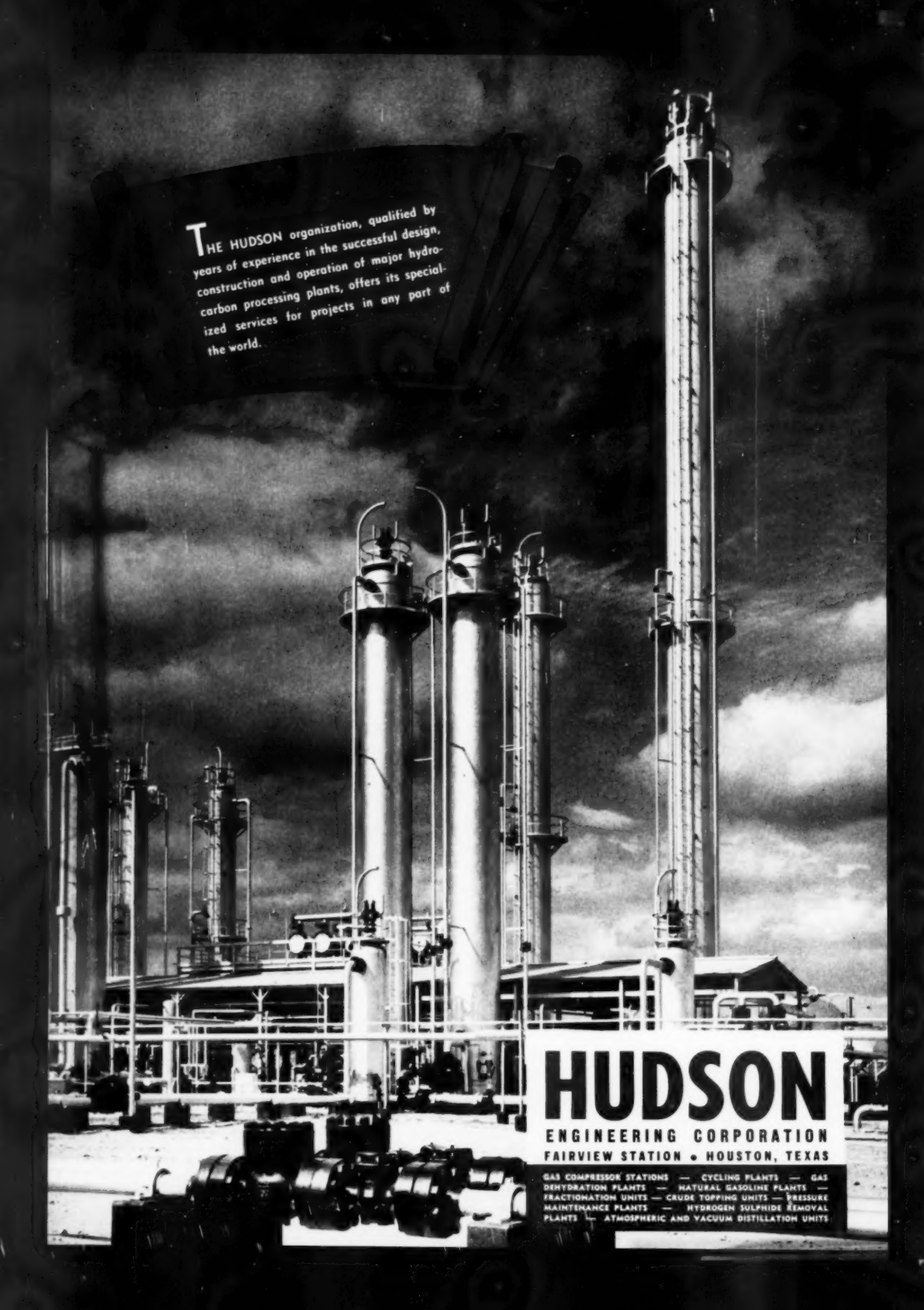
MAY, 1951
VOL. 6, NO. 5

PETROLEUM PROCESSING



1,600,000 Bbls. of New Capacity Needed by End of 1956 . . . p. 485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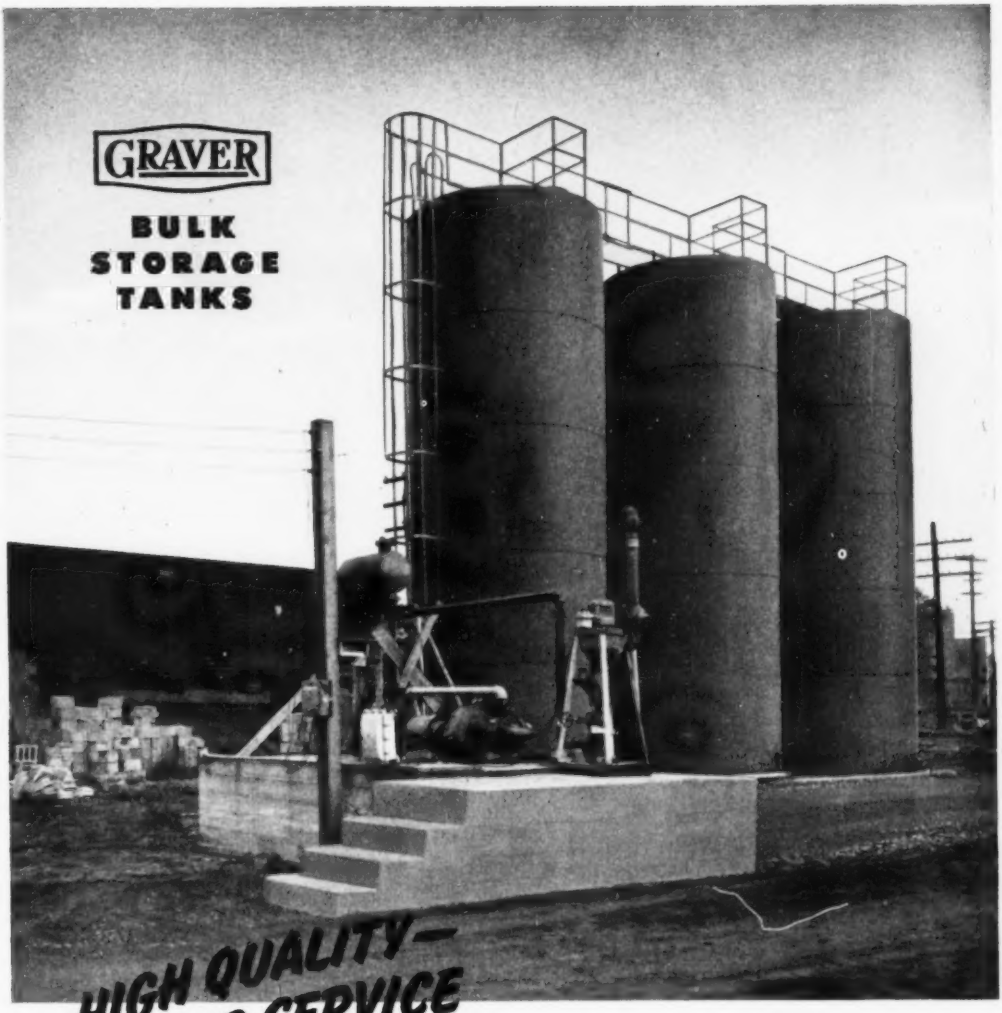

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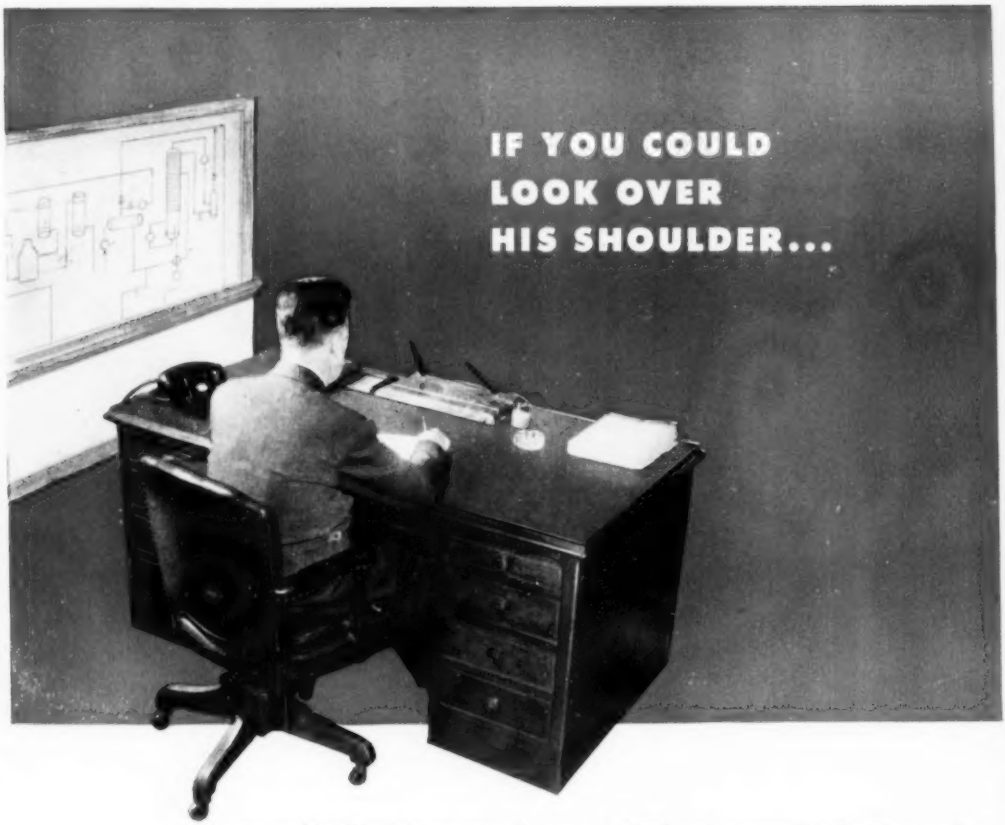

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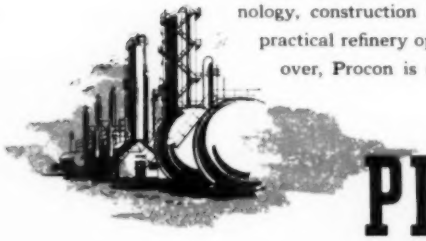

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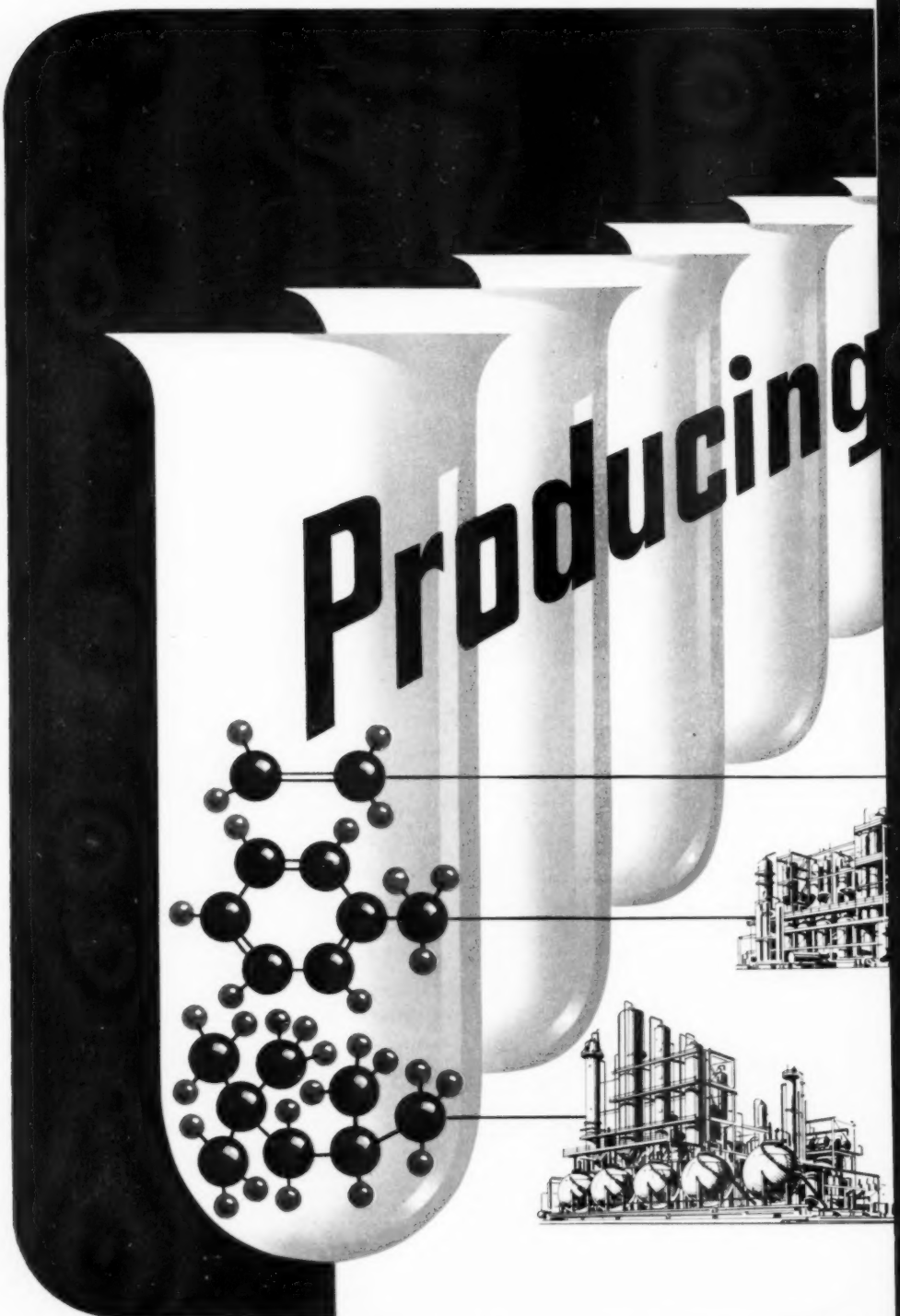

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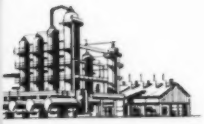

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WHAT'S HAPPENING

Current News Summarized For Oil Men

EXPANSION

Sun Oil Co. plans construction of a new 30,000 to 50,000 b/d refinery in the future, according to J. N. Pew, Jr., board chairman. Company has not said where it will be, except that it will be "strategically located to supply fringe areas of Sun's present marketing territory. Industry sources have indicated that plant might be located in southern Ohio, near Cincinnati and on newly-built Mid-Valley pipeline.

Monarch Refining Co. is planning to build a new 10,000 b/d refinery on site east of San Antonio to supply nearby Randolph and Kelly fields, and Ft. Sam Houston, with avgas, jet fuels and 86 oct. (Research) motor fuel. A fast tax write-off has been granted and application for RFC loan will be made. Project will cost about $12,500,000, including a 4000 b/d Fluid cracking unit, 2500 b/d Platformer and 2500 b/d HF alkylation unit.

Pan American Refining Corp. will increase by 10% the capacity of its 115,000 b/d refinery at Texas City, Texas, to boost avgas production. Tentative plans call for another Fluid catalytic cracking unit and polymerization unit.

Gulf Oil Corp. is planning to expand capacity of its Philadelphia refinery from present 107,000 b/d to 183,000 b/d. New facilities to be constructed will include vacuum and topping unit, another catalytic cracker, reforming unit and supplementary facilities.

Esso Standard Oil Co. is increasing capacity of its Everett, Mass. refinery by 6000 b/d to a total of 38,500 b/d and make it self-sufficient in production of premium-grade gasoline. New facilities to be built include an 18,500 b/d Fluid cracking unit, 7000 b/d re-run pipe still, fractionator, gas compression plant, and new and improved light ends facilities.

Kanotex Refining Co. has let contract to Refinery Engineering Co. for construction of a 4600 b/d Fluid catalytic cracking unit and 5700 b/d vacuum unit at its Arkansas City, Kans., refinery. Crude capacity will be increased from present 8500 b/d to 12,000 b/d. Construction is expected to start June 1, for completion June 1, 1952. Tax amortization certificate for $2,347,423 (75%) has been granted.

Taylor Refining Co. is completely rebuilding its Port Isabel, Texas, refinery to process distillate from the McAllen and Rincon fields. In addition to rebuilding distillation equipment, plant will have a 4000 b/d Platforming unit. Planned completion of crude distillation facilities is set for this month, while reformer will not be ready before September.

One million barrels of new basic capacity must be added to U. S. refineries by end of 1953, according to Bruce Brown, Deputy Administrator of PAD. By end of 1956, new additions should exceed 1,600,000 b/d. More details on p. 485 this month.

Total operable refinery capacity in U. S. is expected to be increased 204,400 b/d or 3.9% during 1951, according to API's annual refining capacity survey. Capacity Dec. 31, 1950 totals 6,856,950 b/d. More details on p. 487 this issue.

• • •

FOREIGN

Refineria E Exploracao de Petroleo Unaio, recently-organized private company in Brazil, will build country's fourth refinery at Sao Paulo. Plant will have capacity of 20,000 b/d and a Thermofor cracking unit, will operate on Middle East or Venezuelan crudes. Contract has been awarded to Hydrocarbon Research, Inc., which designed 45,000 b/d government owned refinery at Cubetao, near Santos.

Petroleos Mexicanos has awarded contract to Arthur G. McKee Co. for construction of complete lubricating oil and wax manufacturing facilities at its Salamanca refinery. Estimated cost is $15 million; products will be made from Mexican crude. Construction, to start immediately with completion dependent on materials, represents large addition to the plant which was completed by McKee a few months ago.

South Africa Coal Oil & Gas Corp., a public company, will build a 60 million gal. per year coal-to-oil plant near town of Coalbrook (50 miles south of Johannesburg) in the Orange Free State, Union of South Africa, which will mark the first commercial application of M. W. Kellogg Co.'s "Synthol" process. Process to be used in synthesis step will employ "a radically new type of reactor to handle powdered catalyst" and "involve new fundamental operating conditions." Plant, now being designed by Kellogg,

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

will primarily produce gasoline and diesel fuel, but high octane gasoline processes will form part of facilities. South African government has put up 18 million pounds (about $50,400,000) as its share of project.

• • •

MARKETS, PRICES

Prices generally were firm and demand strong for refined oils during April, although a number of quotations for principal products were lowered in the Mid-Continent.

Refiners in seaboard districts reported demand for gasoline was especially strong, and there was no letup in calls for heavy fuel and gas oils. Normal seasonal accumulations of light fuel oils have been delayed somewhat by "substantial" purchases, estimated at about 4,000,000 bbls., by foreign companies affected by the oil strike at Abadan on the Persian Gulf.

In Oklahoma, distillate fuel quotations generally were off 0.25c as some refiners sought, with lower prices, to move out their late-season balances. No. 2 prices for tank car lots ranged upward from 8.125c, Group 3.

Natural gasoline prices (Grade 26-70) were off 0.875c per gal. in the Mid-Continent to 5.5c, FOB Group 3, and 5c, Breckenridge. Manufacturers said the decline was sharper than usual because seasonal factors were "helped along" by TEL restrictions.

Orders for lubricating oils and petrolatums are still backlogged, although new inquiry for Pennsylvania-grade bulk shipments has declined, according to reports. A refiner of petrolatums disclosed turning down an order for 300 drums for August shipment. On the other hand, supply of refined wax at New York was said to be running ahead of demand, and "discounts" were reported for most grades.

• • •

INDUSTRIAL MOBILIZATION

Natural Gas Production and Processing Division has been set up by Petroleum Administration for Defense to assure the production of the natural gas and natural gas liquids needed to meet essential industrial and domestic needs. Charles E. Webber, on leave from Sun Oil Co. as asst. manager of their natural gasoline department, has been named director.

Containers and chemicals can no longer be ordered under the M-46 MRO order (see PP, April, p. 365). Although no official ruling has been handed down, PAD has stopped approving purchase orders for these items, and is readying an amendment to M-46 to formally exclude them. General Reg. 4 MRO order has been amended to exclude them and some other items.

Meanwhile, containers can be obtained from manufacturers on a non-DO basis of certain percentage (about 80-85%) of last year's use, and mills have been ordered to supply manufacturers with 66,000 tons of steel for containers for May and June each. Chemicals are handled on same sort of informal allocation, except for those which NPA has already begun allocating (sulfur, for instance, in western states). Refiners handling defense orders, of course, can go to ASPPA for priorities assistance in getting chemicals or containers.

Stillmen, treaters and boilermakers in oil refining and chemical industries are listed by Labor Department among key occupations that will develop manpower shortages in 1951 and 1952 as production is expanded to meet mobilization needs. Department prepared report on over-all manpower requirements for near future.

Iron and steel scrap salvage drive has been started by National Production Authority, aimed at moving 32,500,000 tons of scrap to steel mills this year. PAD has named A. P. Frame, asst. deputy administrator for domestic industry operations; Frank A. Watts, director of Materials Division, and C. P. Rather, asst. deputy administrator for gas, as 3-man committee to push oil industry's part in drive.

APPOINTMENTS—William C. Traver, asst. general counsel for PAD; he was previously with Federal Power Commission . . . **Walter E. Caine** (Texas Eastern Transmission Corp.), director of PAD's Gas Planning Division . . . **Louis C. Sonnen** (Tennessee Gas Transmission Co.), director of Gas Facilities Division.

• • •

PRODUCTS

Second month of restrictions on TEL supplies saw widespread reductions in gasoline octane ratings, with cuts anywhere from 0.5 point to 3 points, according to nation-wide survey by *Oilgram News*. Cuts in octane ratings were principally in districts where the largest refiners are located—Gulf, East Coast, Midwest and California.

DuPont's regular motor gasoline survey, on the other hand, doesn't indicate any great drop in octanes. Ratings for premium fuel dropped in 26 cities in April as compared with January, but rose in 19. Ratings for regular dropped in 30 cities, rose in 12.

Discrepancy is explained by fact that *Oilgram* survey was made among refiners on basis of what they were then making (early April). DuPont survey was made at service stations and on gasolines manufactured for most part back in January and February—before TEL restrictions went into effect.

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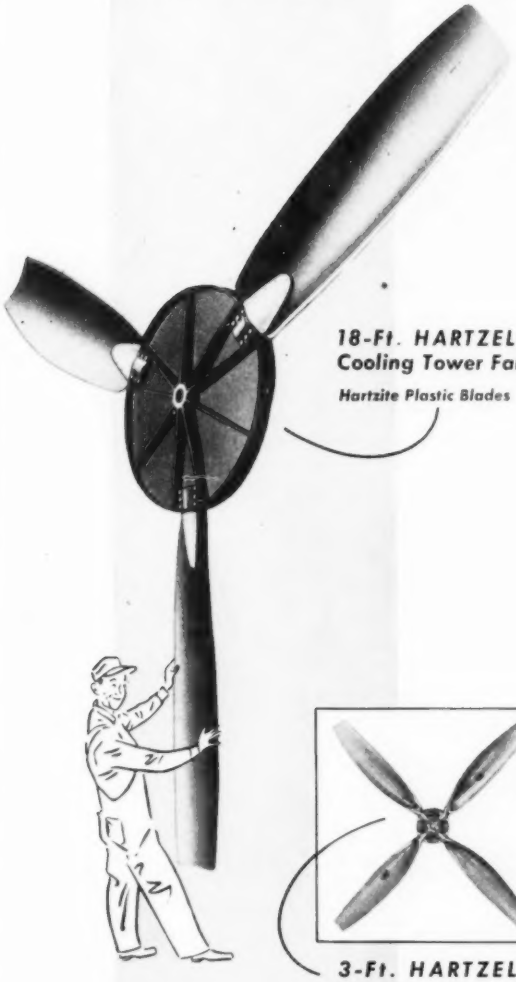

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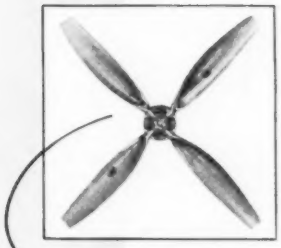
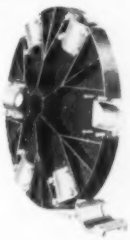
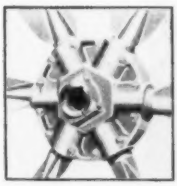


3-Ft. HARTZELL
Cooling Tower Fan
Aluminum Alloy Blades



Steel Fan Hub

Aluminum Fan Hub



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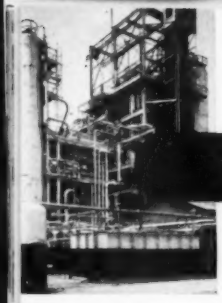

TOMORROW... IN PETROLEUM TECHNOLOGY

Possible Effects of Today's Developments On Future Operations

By the Editors of Petroleum Processing

Air Flotation Offers Solution To Waste Disposal Problem

FOR many years the traditional method of treating refinery waste water has been to use settling basins and standard API separators. Unfortunately, in some instances, effluent has continued to be high in unwanted sludge and oil. Often sludge is too thin and therefore difficult to dispose of or recover. Temperature, flow rates, solids concentration, and other variables tend to upset successful oil recovery and water clarification.

As an accessory tool to the conventional separator, one refiner made satisfactory use of a precoat vacuum filter a year or so ago.[1] More recently, attention has been paid to the so-called dissolved, or colloid-air, flotation technique.[2, 3] This procedure removes suspended solids from the effluent by flotation with tiny air or gas bubbles with a maximum diameter of 0.001 in. or less. The bubbles attach to individual or agglomerated particles and buoy them up to the surface of a flocculation tank where the accumulated floating sludge can be skimmed off.

A recent article[2] discussing the use of this technique in a variety of commercial applications, reported that recovered sludge can vary from 2% dry solids to as high as 90% in a liquid fat separation. The full scale units operate at flow rates of about 3 gpm./sq.ft. of tank area.

At a small Massachusetts lube oil plant, John L. Ray Oil Co., South Braintree, a flotation unit using gas instead of air bubbles has been installed in the effluent line ahead of two API separators which had not been stopping oil from entering the sewers. The situation had been such that local authorities had closed the sewer, forcing the plant to shut down. With the air flotation unit, effluent was improved so that the sewer was re-opened. Operation has been successful since that time, although oil content of the waste water has ranged from 40-50 ppm. to as much as 90% on occasions of accidental oil dumping.

Commercial units usually include a method of chemical treatment as well as the air-bubble introducing device and the flocculation tank. The high efficiency of air flotation permits use of relatively small equipment. Cost figures, as presented in an API Refining Division paper this month,[3] seem to be in line for the results obtained.

Chemicals cost ranges from $1.00 to $10.00 per 1000 bbls. of effluent treated. Cost of the equipment capable of treating 1000 gpm. of water is approximately $25,000, plus installation charges. A unit of that capacity can be installed on a flat concrete slab approximately 16 ft. wide by 45 ft. long. Units are semi-automatic in operation, requiring only daily attention to chemical mixing and checking for lubrication, usually from 1 to 3 hrs. attention per 24-hr. day.

An indirect potential saving, now under consideration by a large West Coast refinery, is re-use of clear effluent in the plant cooling system. Lowest oil content this refinery obtained with conventional waste treatment was 50 ppm. Existing requirements in this area specify oil content of 25 ppm. or less. Tests with an air-flotation unit added to the treating system have cut oil content to 5-7 ppm., virtually crystal clear water.

Increasing Market Seen For Petroleum Xylenes

REFINERS can take comfort for future markets for their aromatic production in the fact that chemical research is sure to keep pace with the increased production of the xylenes—ortho, meta and para—coming with the mobilization boom in production of benzene and toluene from petroleum hydrocarbons. It is doubtful, however, if refiners have overlooked the fact that the xylenes are produced in almost equal quantity with benzene due to their value in upgrading octane value of motor and aviation gasolines.

The chemical industry has paid little attention to the xylenes heretofore, but this attitude reportedly is long overdue for reversal.[4] Only in the last few years has there been much work done on the possibilities of these materials as chemical intermediates.

Most of the present day industrial usages have centered about ortho- and para-xylenes, using oxidation processes to produce from them phthalic anhydride and terephthalic acid, respectively. The latter may be expected to find extensive use in synthetic fibers, while phthalic anhydride has many well-established uses, with more probably in the offing.

Separation of the xylene isomers is necessary for their chemical utilization, while ortho-xylene also is said to have the least value as an aviation gasoline blending stock. Consequently its removal would have a double-barreled economic value to the refiner. The xylenes mixture from hydroforming or from coal-tar distillation reportedly is 20% ortho, 50% meta and 19% para, with 10% ethylbenzene. The latter material, incidentally, is dehydrogenated to make styrene for synthetic rubber and plastics.

Ortho-xylene may be separated from the other isomers by careful fractional distillation; the temperature difference is 9° F. between ortho and the remainder of the mixture, which has a boiling range of less than 3° F. Fractionation is not practical in separating the balance of the mixture.

This separation generally is accomplished by fractional crystallization to remove the para isomer from the mixture, while the separation of meta-xylene from ethylbenzene involves selective sulfonation followed by hydrolysis. Fractional crystallization costs between 1 and 2c per lb; sulfonation-hydrolysis about 1.5c per lb. Price for the para isomer, based on purchases by du Pont from Oronite Chemical and Esso Standard Oil Co. is somewhere in the neighborhood of 25c or below, and the value of the meta-para mixture is approximately 6.5c per lb.

Growth prospects are forecast as good, some of the present large-scale usages having been unwrapped only since World War II. Mobilization conditions may tend to retard chemical developments for meta-xylene but the combination of availability, low cost and product diversification indicate its popularity will keep pace with the other two isomers.

Pneumatic Transmission's Safe But Electricity's Much Faster

IN a field as dynamic as process instrumentation, particularly when concerned with another field equally dynamic — petroleum processing — you'll find the top engineers and development men are never satisfied with the "status quo."

For example; in the little over two years since the graphic panel got its tremendous forward spurt, this type of equipment has already become "old fashioned." Virtually every new refinery unit being built today in-

corporates a central panel board of the graphic style in one form or another. The idea has become commonplace for discussion whenever instrument men gather. And from these discussions and the ideas taken home from them, plant operators can anticipate a rapid evolution to an "ideal" graphic.

But progress in the speed and accuracy of process control through graphics has brought out from the the background another problem—that of lack of speed in pneumatic transmission. Most of today's control systems employ air for transmitting signals of process variables to central indicators and recorders.

Today's instrument thinking is leading toward the use of electricity instead of air, toward learning from the communications, radio, and electronics engineers who have long been familiar with ultra high speed transmission of signals.

The obvious chief obstacle to using electricity has been its traditional hazard, particularly in petroleum processing, where flammable hydrocarbons are ever present. Chief advantage — a very pertinent one — is electricity's speed. One petroleum refinery proponent for electricify argued during a recent symposium[5] that the safety problem is highly over-rated. For example: explosion-proof fixtures, conduits, etc., have long permitted the utilization of high voltage, high amperage power in the refinery; and secondly, electrical circuits for signal transmission can be as low in power as those for thermocouples—already acceptable to refiners. Secret to safety in electricity was further emphasized in that high-frequency currents—as in the communications industry—can be the workhorse.

A vivid example of electricity's advantage was made during this same symposium: "Consider communicating between New York and San Francisco. If it were possible to transmit sound through air that far, it would require about five hours for a signal in one direction. A 'yes' and 'no' conversation would take 10 hours. If the sound vibrations were transmitted through steel, it would require 40 minutes for the same round trip. With electrical transmission, the transit time is cut to less than 0.04 second."[6]

This speaker cited the results obtained in other fields with electrical controls — gunnery control, rocket direction, or even high speed elevator control. He suggested borrowing ideas from the already existing high speed electronic computing machines, from the pulse and scanning systems in radar.

Your "automatic refinery of tomorrow" is just outside the door now. Just flip that *electrical* switch and open the door.

Petrochemical Industry Again on the March

BUILDING of new petrochemical plants is again on the boom, after a lapse of about two years while the industry caught up with its post-war expansion spree.

According to a recent survey[7] hydrogen cyanide, acetylene and benzene are being added to the list of chemicals to be produced in important new quantities from petroleum raw materials, while at the same time many long-established petrochemicals are being expanded.

In the hydrogen cyanide field, Rohm & Haas Co. has long been the lone petrochemical wolf, using methane and ammonia in its plant outside Houston. Three other companies are now building four new plants to utilize petroleum hydrocarbons to make this chemical—an important ingredient for acrylonitrile and other products.

Monsanto is building a plant at Texas City, where the hydrogen cyanide will be converted to acrylonitrile for synthetic fibers. Carbide & Carbon has a plant under construction at Institute, W. Va., also aimed at acrylonitrile, and reportedly is already planning to expand the operation. DuPont has nearly completed one hydrogen cyanide unit at Victoria, Texas, and has started a second at Memphis, Tenn.

Acetylene, for many years a petrochemical dream, at least on a commercial scale, is now approaching reality. Monsanto is leading the way at Texas City, where a plant is being built to use the so-called Sachse process for partial combustion of natural gas to produce acetylene.

Another acetylene venture is that of Wulff Process Co., which is erecting a small demonstration plant near Los Angeles to produce the gas by regenerative cracking of petroleum hydrocarbons.

Benzene is probably the most important petrochemical now bursting out at the seams. In the past, oil's contribution has been relatively small —12 million gals. annually from Pan American at Texas City and from Shell on the West Coast. Today, however, refiners are being asked to boost that to over 100 million gals. a year.

Largest benzene venture so far announced is that of California Standard, which has now designed a plant to be built at Richmond, Calif., to turn out 13,000,000 gals. a year, utilizing UOP's Platforming process. Atlantic Refining also plans large-scale benzene production at Philadelphia, using its own recently-announced catalytic reforming process.

Aside from this greatly increased interest in petrochemicals—a good deal of it by oil companies—another significant factor stands out. Many of the new plants, including some of the largest, are being built elsewhere than in the Texas Gulf Coast area. It may be that future years will see the petrochemical industry shifting away from the Southwest.

Bottom Loading May Replace Overhead Racks in Plants

IN THAT new refinery you're planning to build you'll probably be able to eliminate the usual space-consuming, hazardous and unsightly overhead loading racks for filling tank trucks and cars.

Shell Oil Co. last fall was reported[8] to have developed a new method for the bottom loading of gasoline trucks at the Washington National Airport, applying underwing aircraft refueling equipment now used by Northwest Airlines.

Key unit in the new method is a coupling and valve arrangement (probably of the quick-disconnect type), linking the bottom of the truck and the free end of the delivery hose.

The device prevents leakage and permits control of the flow of gasoline, Shell says. A special safety valve at the top of the truck prevents overflow.

More recently a second major oil company began experimenting with bottom loading at one of its terminals, and has reported that results have proved "highly successful" and that the method will "revolutionize" terminals of the future.[9] An executive of the company predicts that bottom loading will be used at all new terminals built by his company.

Advantages cited for the new bottom loading method include:

1) Safer loading because the operation is carried out with employes on the ground.

2) Less product loss due to evaporation, which occurs with present loading methods.

3) Reduced construction costs because of elimination of the need for any overhead structures.

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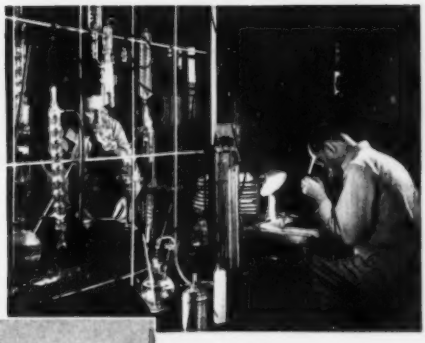

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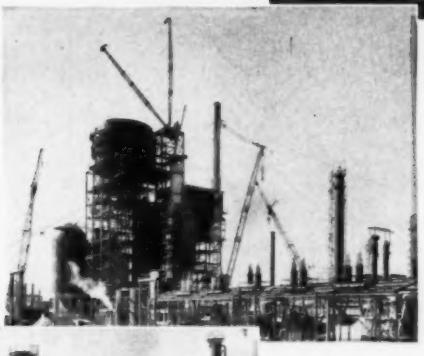

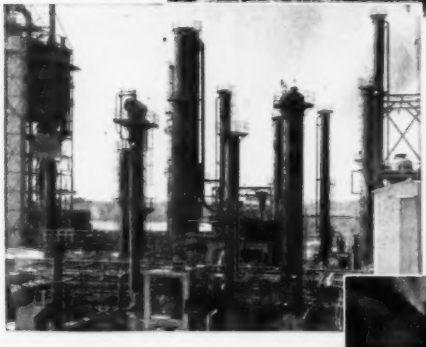

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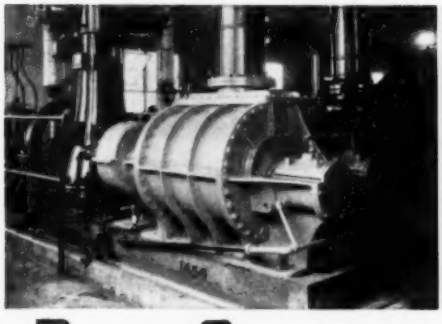

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LETTERS

Cleaner Exchangers

Your article on cleaning heat exchangers [April PP, p. 370] is very interesting and deals with a problem that is troublesome to all refineries. The part on chemical cleaning of exchangers was especially interesting. A number of refineries practice such methods as mechanical, sandblasting, and high pressure water. However, the number using chemical means to my knowledge is very limited.

It appears there is room for a high degree of development of the chemical method. Thus, any information on this method would be received with interest by refineries that are concerned with reducing high maintenance costs.

R. J. HAFSTEN
Manufacturing Dept.
Standard Oil Co. (Ind.)
Whiting, Ind.

Insulation "Slip" Covers

The "cover picture" for the July 1950 issue of PETROLEUM PROCESSING shows a battery of exchangers on which aluminum slip covers were used to protect insulation.

It would indeed be appreciated if you could obtain for us the construction details of these slip covers.

GEO. L. BARKER
Tide Water Assoc. Oil Co.
Tulsa, Okla.

Fuller-Austin Insulation Co., Houston, handled the construction of these slip covers—but with the present critical supply situation on aluminum it appears unlikely that this material will be available for such purposes in the near future.

Safety with Volatility

Very little can be said that would improve the presentation of the article "Safe Handling of Volatile Materials" (April PP, p. 378); however, readers might be interested in contacting Esso Standard Oil Co. for additional information of this new training program. It might be advisable to indicate where and to whom inquiries should be directed.

M. J. NETERER
Safety Director of Refineries
Sinclair Refining Co.
E. Chicago, Ill.

For any additional information, The Esso people suggest readers contact Mr. H. G. McBurney, assistant general superintendent at the Baltimore, Md., refinery of Esso Standard Oil Co.

Readers are invited to express their views or comments on material published in PETROLEUM PROCESSING. Send them to:

Letter's Editor
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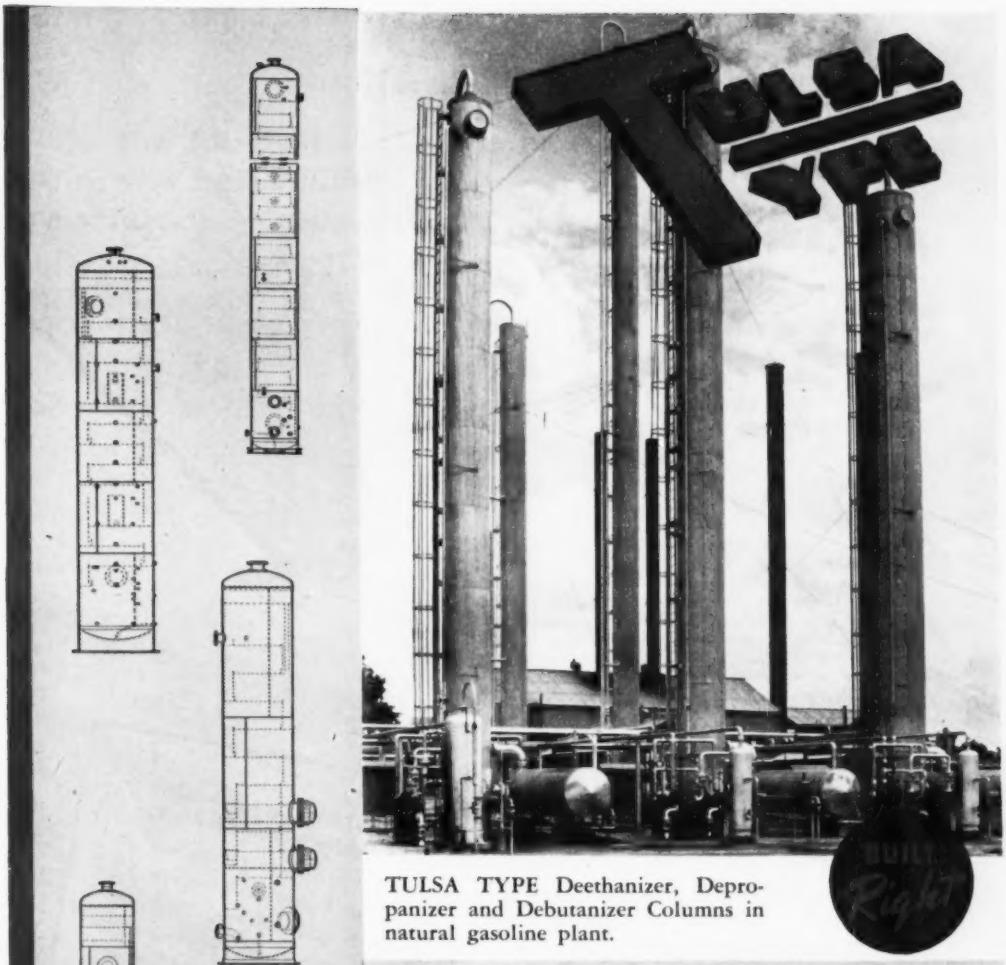

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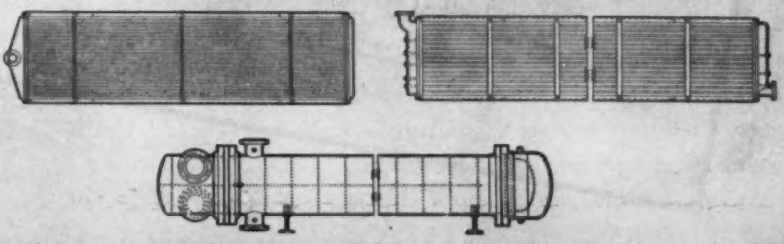

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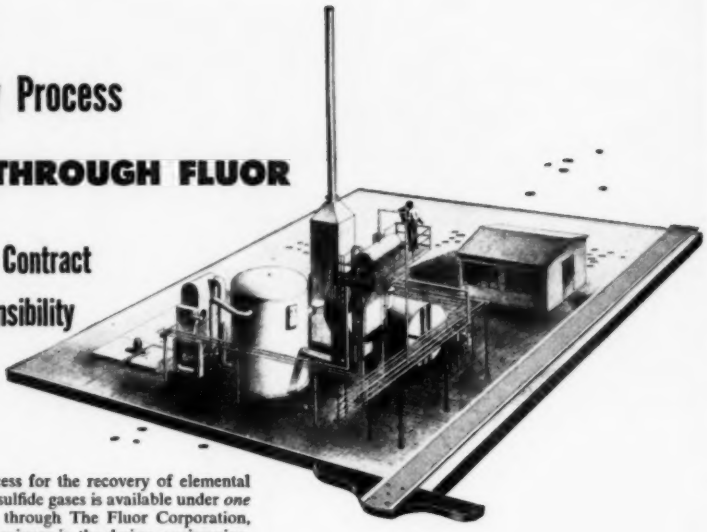

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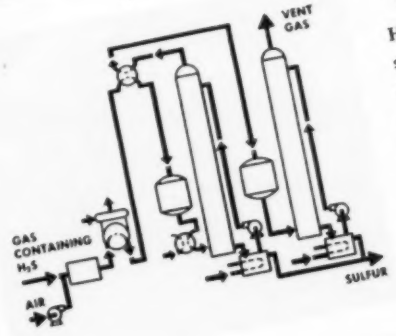
A Simple Process for the Conversion of Waste Hydrogen Sulfide to Pure Elemental Sulfur



Hydrogen sulfide, recovered from a sour gas stream, is partially burned with air—cooling follows with steam generated being utilized for power. Combustion gases are then passed through a catalyst tower to form sulfur and water vapor. Elemental sulfur product is condensed in a wash tower by direct contact with cooled liquid sulfur. The result is pure commercial sulfur—ready for sale or for conversion into sulfuric acid.

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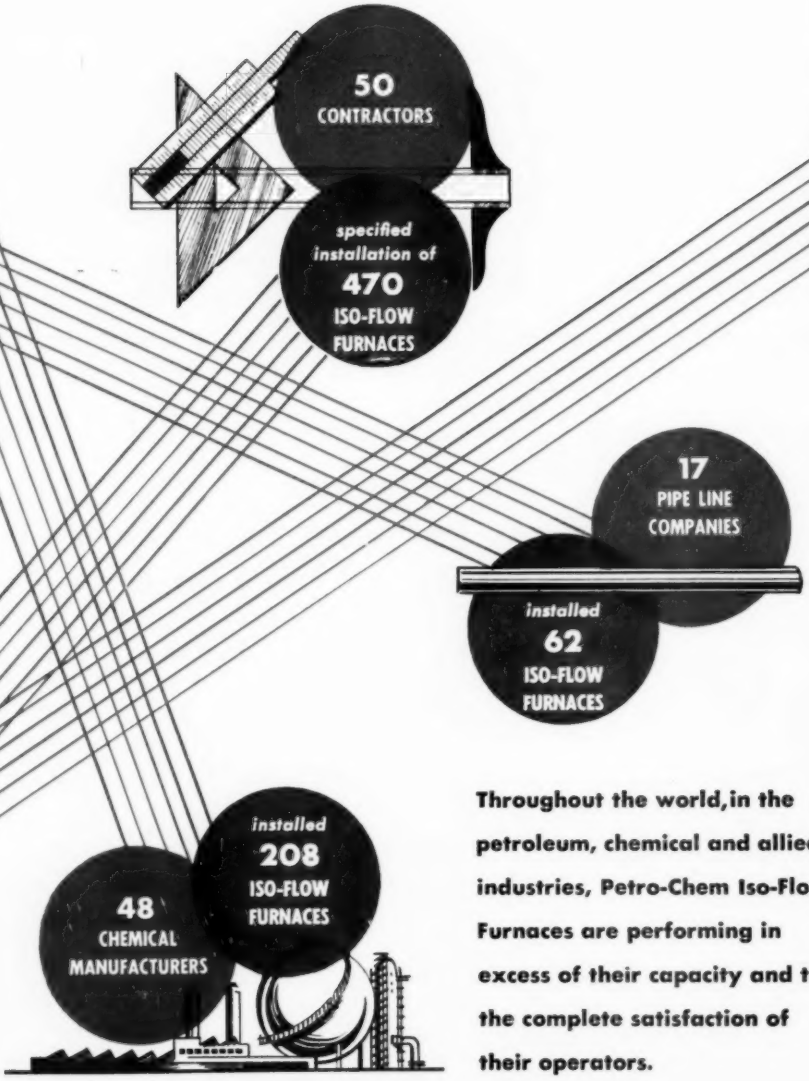

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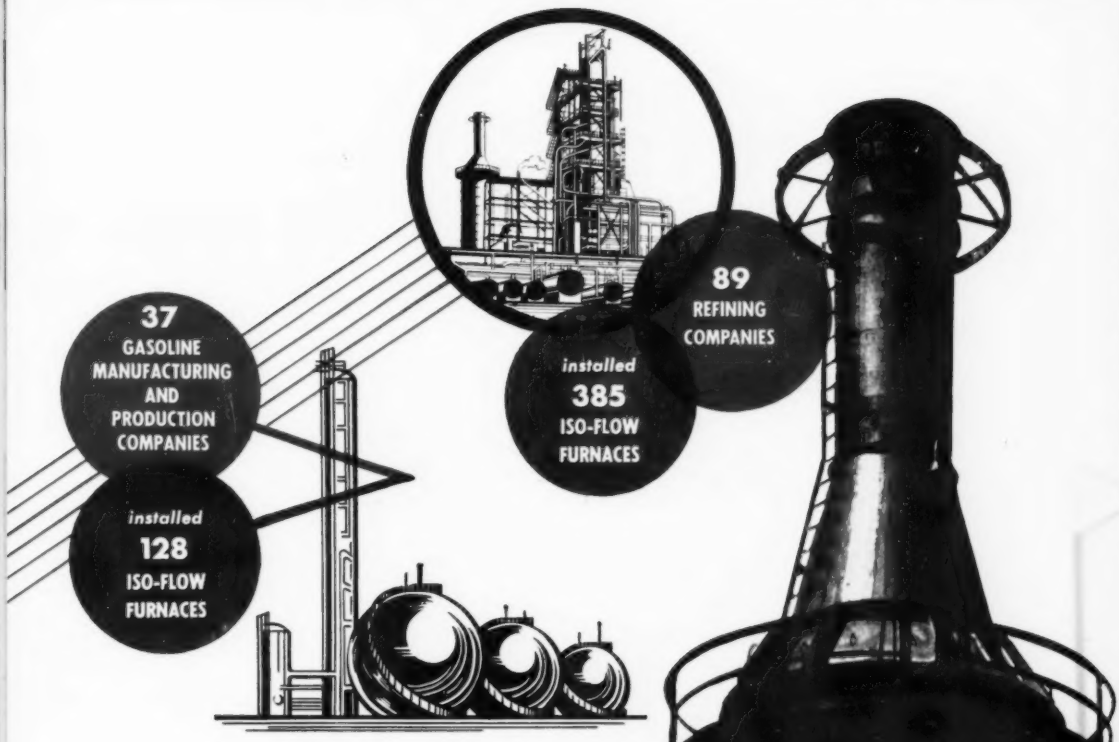

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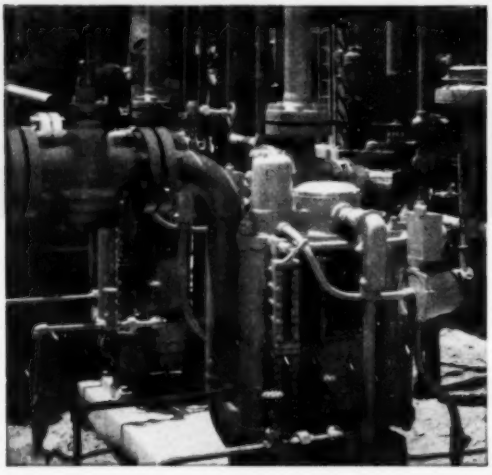

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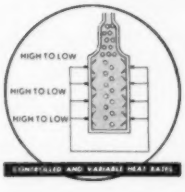

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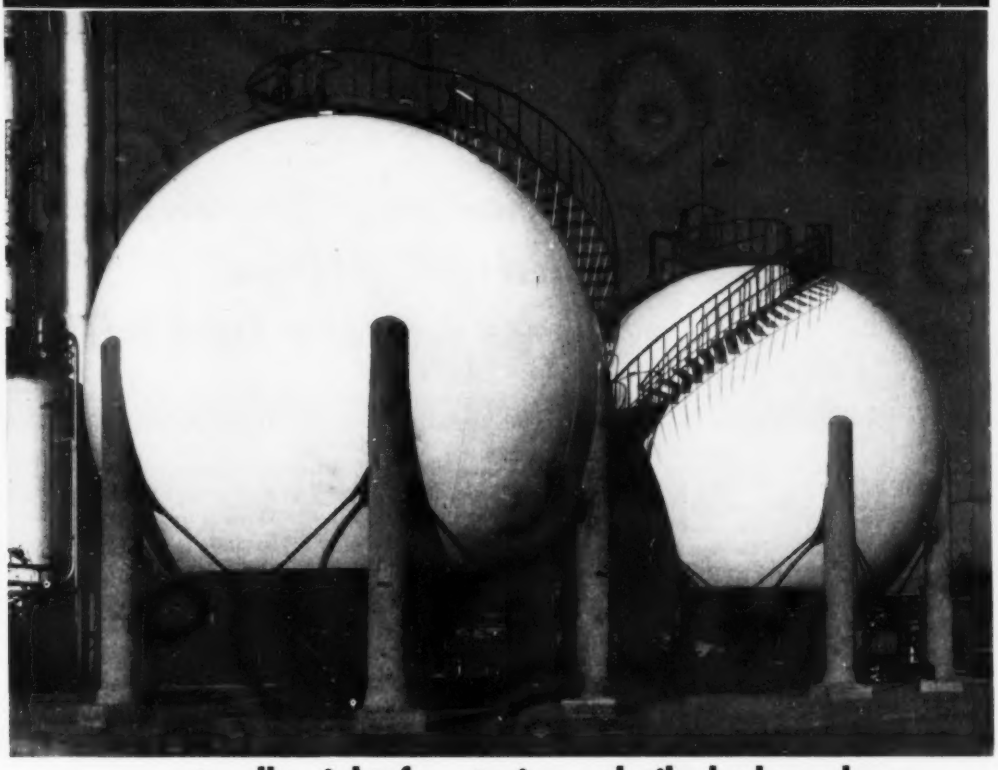

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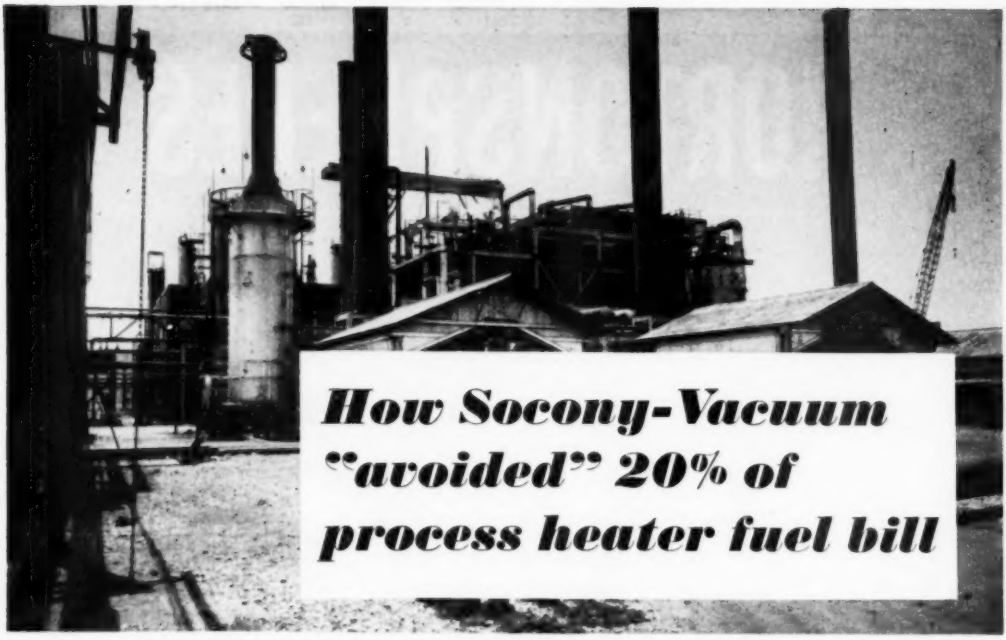

How Socony-Vacuum "avoided" 20% of process heater fuel bill

program

When engineers at Socony-Vacuum, Trenton, Michigan refinery developed a complete fuel conservation program, process heaters came under close scrutiny. Socony-Vacuum engineers felt they could reduce the total cost of fuel used in raising the temperature of petroleum stock if they could keep the amount of excess air in the flue gases at a minimum.

need

Socony's instrument engineers wanted an instrument which would indicate excess air, so that they could make adjustments to keep the air at a minimum and thus save fuel.

specifications for instrument

must provide a **continuous indication** so that changes could be spotted immediately.

must **not be affected by changes in fuel composition** since different fuels are used in the heater furnaces.

must not **be affected by the presence of Hydrogen** in the gas sample.

preferably, measurement should have **direct relationship to excess air.**

selected

four HAYS MAGNO-THERM OXYGEN ANALYZERS and two HAYS 2-PEN ELECTRONIC RECORDERS

results

The entire fuel conservation program brought a 20% reduction in Socony's annual fuel bill. The Hays Oxygen Recorders have proved an effective combustion guide on the process heaters.

Improvement in the efficiency of your process heaters can mean large fuel savings. Write for Bulletin 50-829, 16 pages of information on how the O_2 meter works, where it's used, etc. No obligation.

THE **HAYS** CORPORATION *MICHIGAN CITY* 2? *INDIANA* • Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters • Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages • Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

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Dots on the globe indicate countries where scores of post-war refinery and chemical projects carry the seal "... by Lummus".

All classes of Lummus service—process design, engineering, construction—are represented in these overseas projects. In a number of cases, combined projects constitute complete oil refineries.

Processes employed include distillation; propane deasphalting; catalytic and thermal cracking; reforming; Polyforming; coking; lube oil manufacture by solvent refining, solvent dewaxing and clay treating; and petroleum chemicals production.

Each job—whether just starting, partially completed, or on stream—bears the Lummus stamp of over-all competence and international experience.

We invite you to consult Lummus on *your* next project.

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piping maintenance *costs more* now!

You do less of it by using Dependable Quality

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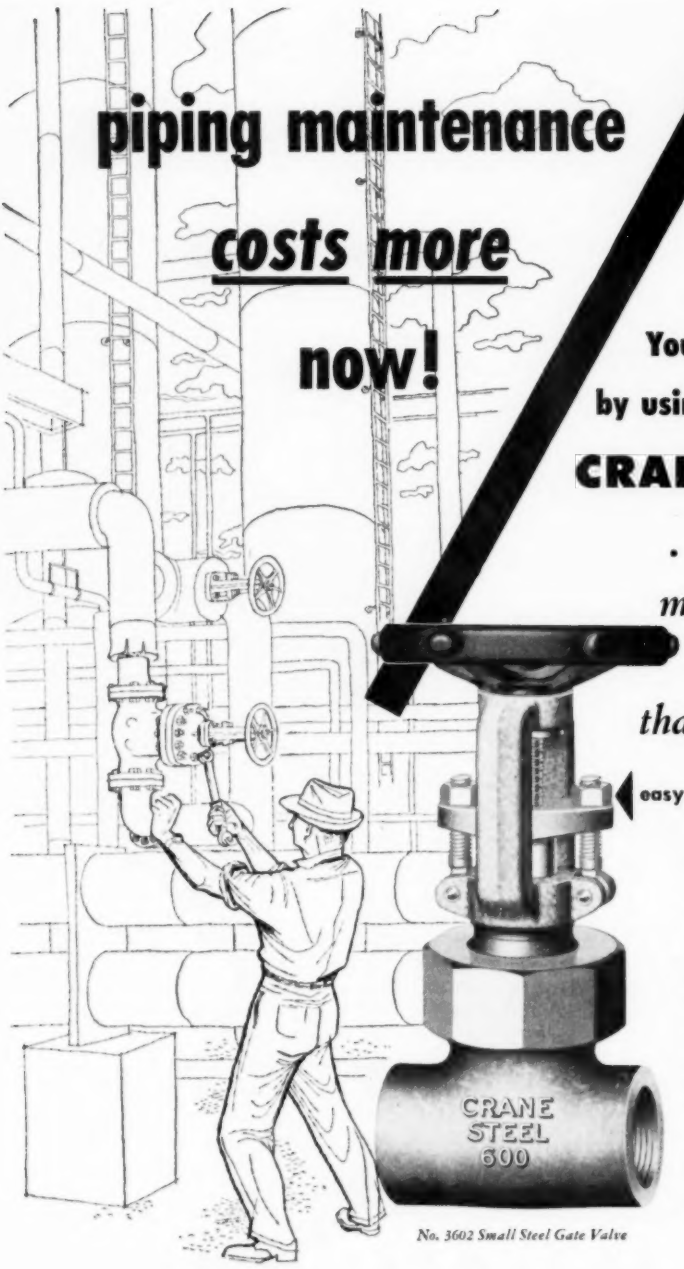

No. 3602 Small Steel Gate Valve

easy to use...easy to keep on the job

You'll have much less valve maintenance wherever you install Crane 600-Pound Small Steel Gates. Use with recommended trim on oil or oil vapor, steam, water, air, or gas.

Compact yet rugged—light yet strong—these are truly small steel valves with big valve features. They sacrifice nothing that insures dependability and tight seating, easy operation, and convenience in keeping them in top-notch working condition.

Supplied in sizes 2 inches and smaller, No. 3602 valves are engineered to the standards that make Crane Quality your best choice in valves of every type.

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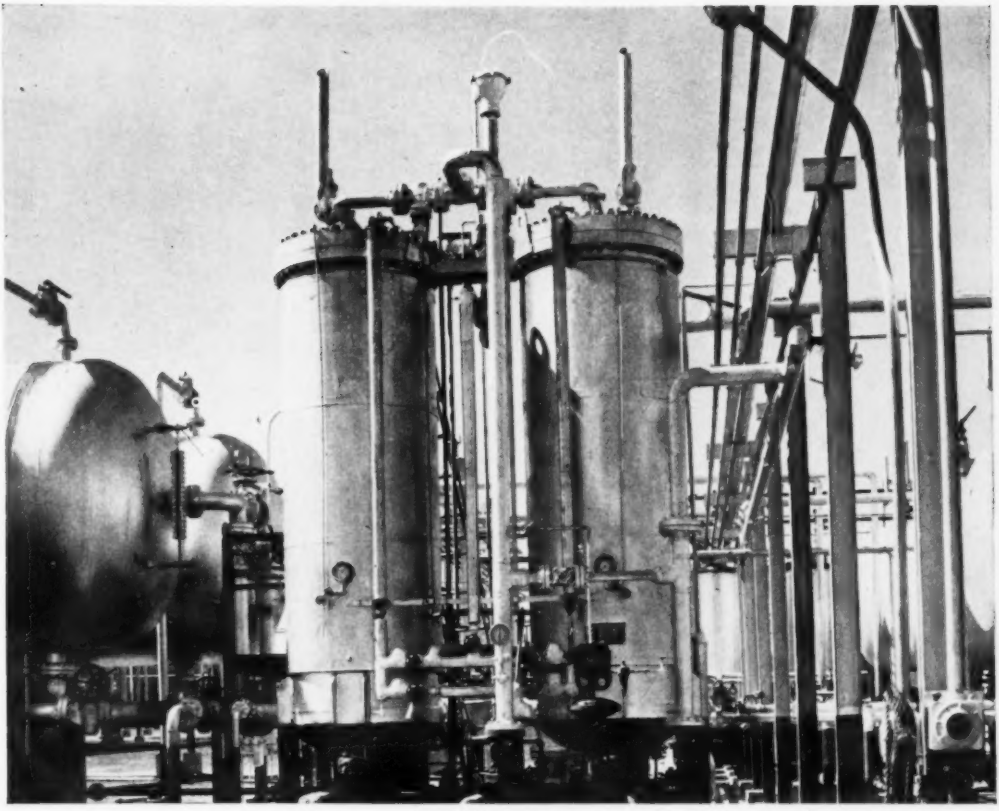


Type BWC-3500 Lectrodryer at Shell Oil Company plant, Notrees, Texas.

DRYing propane at SHELL

Lectrodryers catch the moisture which separators and filters let by, DRYing hydrocarbons in either the liquid or gaseous stage. In this Shell Oil Company installation, liquid propane is processed.

Hydrocarbons for chlorination must be DRY, to prevent vicious attack of the steel in the chlorinators. Lectrodryers are placed on-stream to DRY them, therefore, as they pass on for further processing.

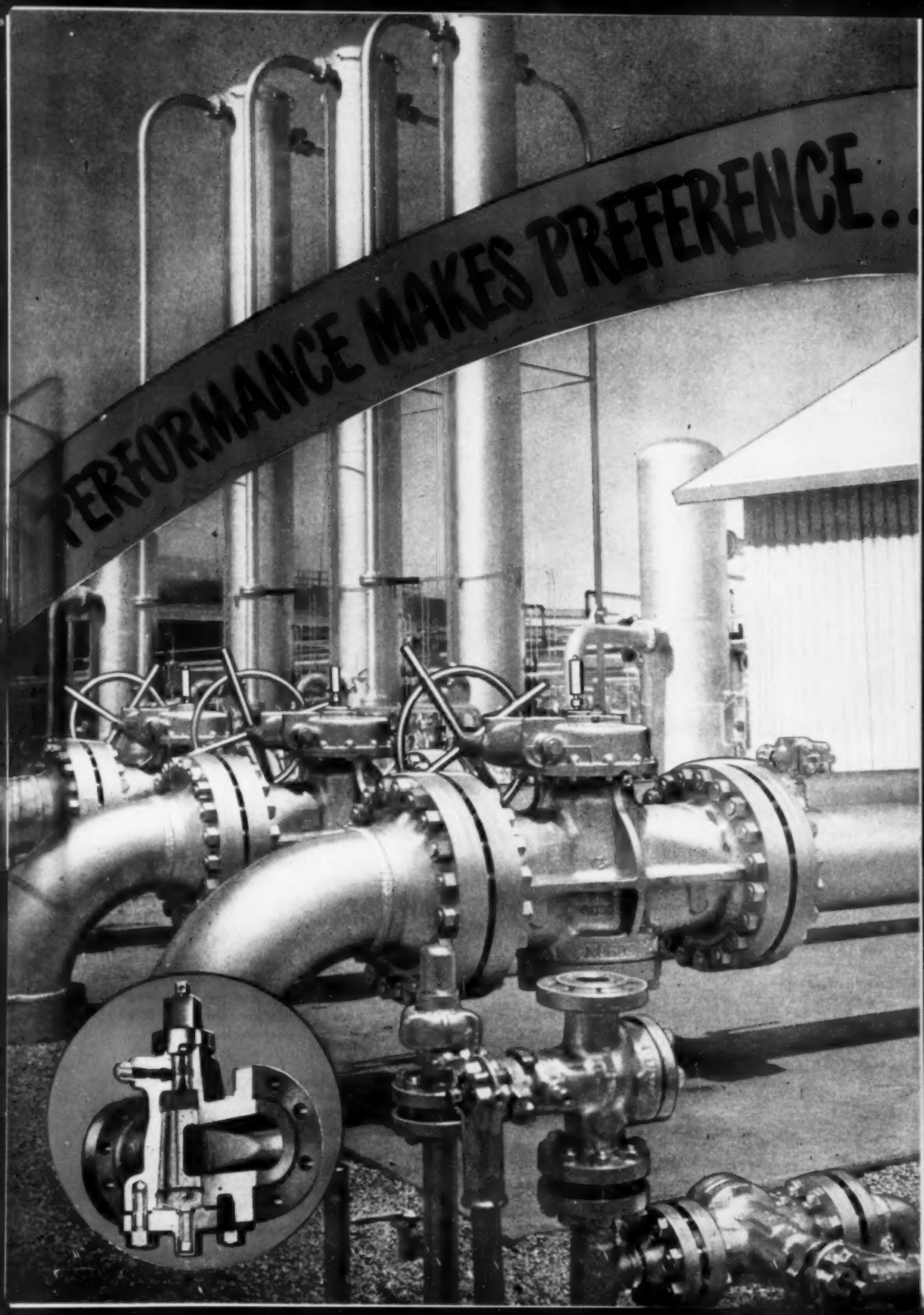
Hydrocarbons must be DRY before being fed into reactions where HF is the catalyst. And, in many cases, the purchaser specifies a DRY hydrocarbon for reasons of his own. Lectrodryers are doing all those DRYing jobs.

You can get extreme DRYness with Lectrodryers —down to 3 to 4 parts per million or less. Our engineers will help you lay out the system and select the proper equipment. For this help, write Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.

LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS

LECTRODRYER
REGISTERED TRADEMARK U.S. PAT. OFF.

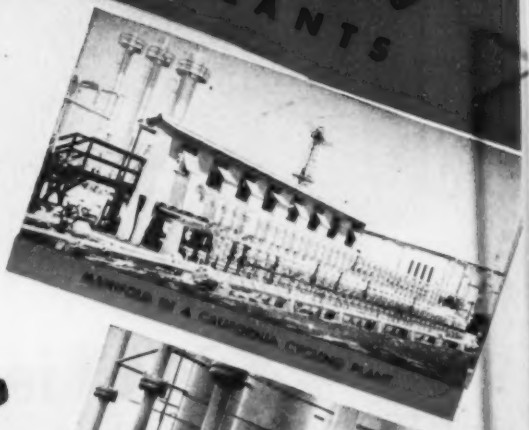

PERFORMANCE MAKES PREFERENCE...

KEEP UPKEEP DOWN

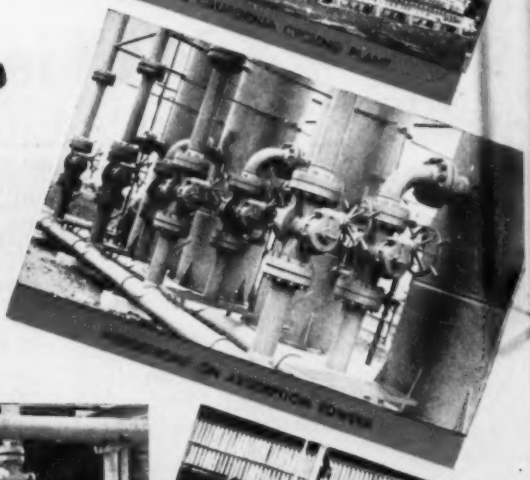
in Cycling and Natural Gasoline PLANTS

Nordstroms
are the predominant choice

You can't take a chance with leakage in gasoline production. You insure safety by installing Nordstrom lubricated valves. Constant pressure of the lubricant seals the ports, blocks intrusion of line fluid to the seat, keeps the valve in easy operating condition and provides means of hydraulically jacking the plug if it ever becomes too tight. Nordstrom quality, Nordstrom endurance, Nordstrom performance and Nordstrom field service all combine to give you greatest value and economy. By using Rockwell Hypermatic lubricant, you get more economy than ever—*automatic lubrication*—with tremendous savings in maintenance time plus further insurance that the valves are kept in a 100% lubricated condition for unsurpassed performance.



VALVES IN A CALIFORNIA CYCLING PLANT



VALVES ON A LOUISIANA GASOLINE PLANT

Nordstrom Valves

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ROCKWELL MANUFACTURING COMPANY

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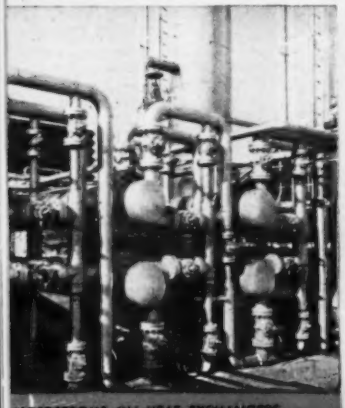
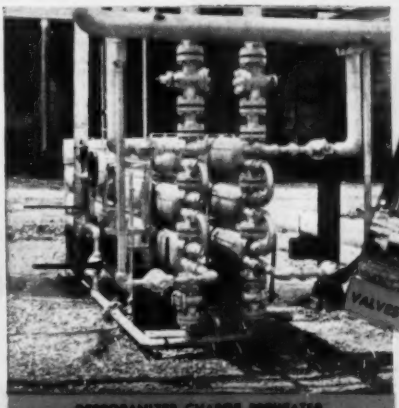
Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses • Export: Rockwell Manufacturing Co., International Division, 7701 Empire State Bldg., New York 1



NORDSTROMS ON HEAT EXCHANGERS



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VALVES ON HIGH PRESSURE LINES IN LOUISIANA

IVAN is watching you

IVAN is a dyed-in-the-wool Communist. There are only 6 million party members like him in all Russia, yet these Communist brass-hats enforce the iron dictatorship of the Kremlin over *200 million* Russians.

He's sold to the hilt on Red ideas. Which means he's out to get *you*. He believes it's either you or him . . . that the world is too small for both.

Ivan is working hard to beat you down. He has a big head start.

Right now he's got you in a bad spot.

Ivan is afraid of only one thing.

He fears your ability to out-produce him in guns, tanks, planes.

Frankly, he doesn't think you value your free system enough to do it . . . to make willingly the sacrifices he has squeezed out of the Russians.

But he's wrong!

Because you and all of us have set out to build more and better weapons—to do it faster all the time.

We must use every bit of know-how and inventive skill we have to improve our machines and methods—to turn out more and more for every hour we work. Only in this way can we become militarily strong.

But we've got to supply essential civilian needs as well. We can't allow needless shortages to take prices skyrocketing and lower the value of our dollar.

Sure, that means sacrifices for everybody. But doing this double job well is the only sure way to stop Ivan in his tracks—and to save the freedoms which are ours and which he has never known.

FREE . . . this important booklet tells you how our American System Grew Great

How Americans developed better machines, power and skills to build a great nation . . . Why we have been able to produce constantly more per hour . . . How this has given us the world's highest living standard.

How we can meet today's challenge—Why we must expand our productive capacity . . . supply arms and essential civilian needs, too. Read how this dynamic process works in free booklet, "The Miracle of America," endorsed by representatives of management and labor. Send for your free copy today!

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1901-1951

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Avgas, rubber and anti-freeze in the raw . . . for Shell!

In 1942, Kellogg undertook its first domestic process and construction work for Shell—three Fluid catalytic crackers simultaneously—two for Wood River, Illinois, and one for Dominguez, California.

This was "matched" by an assignment to build a government-owned butadiene plant—according to designs furnished by Shell Chemical, the ultimate operator—in California. During the following years, Kellogg designed and constructed desophalting and phenol treating units for lubricating oil production in this country. In the early thirties thermal cracking facilities were constructed in France for Shell's associate, Compagnie de Raffinage Shell-Berre.

Most recently, Kellogg has built major units for the production of ethyl chloride and for processing hexylene glycol from diacetone alcohol at the new famous Deer Park plant of Shell Chemical.

THE M. W. KELLOGG COMPANY
A SUBSIDIARY OF PULLMAN INCORPORATED

for fifty years an integral part of processing history

NEW YORK JERSEY CITY LOS ANGELES TULSA HOUSTON TORONTO LONDON PARIS

Portrait at

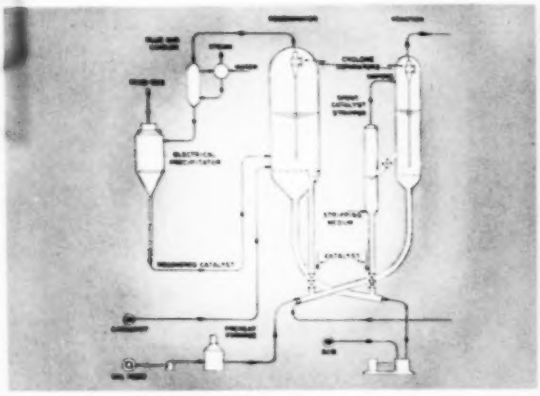
This year is Kellogg's fiftieth of service to industry. At this time naturally, as a group of men—known collectively to the modern business world as The M. W. Kellogg Company—we can think back nostalgically. We can remember the chimney stacks

"Harnessing the Specialties..."

In previous issues of this magazine, camera "portraits" of M. W. Kellogg today have highlighted the major aspects of Kellogg's widely diversified chemical, process, metallurgical and equipment development program.

This month, development work in the specialty of chemical engineering leads logically to the introduction of the fountainhead of Kellogg's service to industry—Process Engineering.

1. ***FROM THE BROAD CANVAS*** of Kellogg development activity, let us turn to the specifics of chemical processing—starting with the *Chemical Engineering Development Group*. The chemical unit processes and operations are its responsibility, including heat exchange, solvent separation, diffusion and the action of fluidized solids (pictured)—the latter vital to modern refinery processing.



4. ***BUT ALL THIS DEVELOPMENT*** work has only one end purpose: More efficient processing plants, achieved either through improved processes or improved process equipment. Thus *Process Engineering* is truly the fountainhead through which Kellogg serves industry. The Process Engineering Department is made up of men of varied talents, varied experience and varied functions.

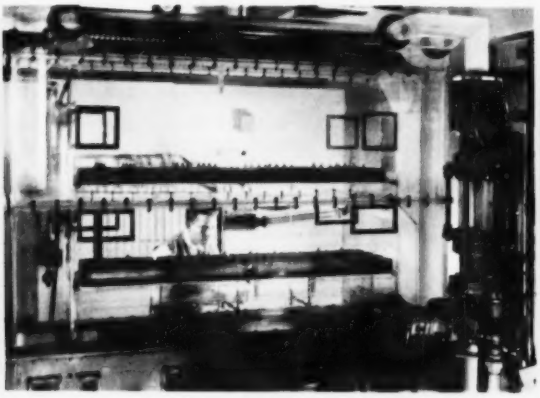
5. ***FIRST TO CONTACT*** any customer are those engineers charged with creating the optimum process sequence—combinations of two or more processes—to accomplish a desired industrial task. Thus, they work continually with dollars-and-cents as well as throughput, stream efficiency and product quality. These process specialists are supported in this work by a sizeable *Economics Group* which is an integral part of the department.

Fifty... no 4

KELLOGG
1901 1951
50th Anniversary

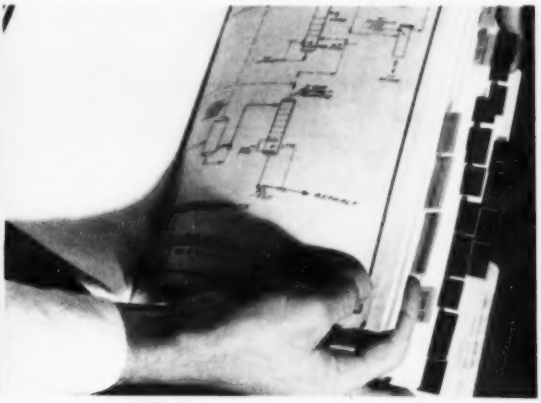
we built in 1901 . . . the first crude vessels for oil refiners in the 'teens . . . our first combination unit. The forty-odd Fluid cat crackers built in these years. But, after all, The M. W. Kellogg Company is only a factor as it is able to serve industry today. For that reason, we are presenting this series of monthly camera studies which document our belief that a truly integrated organization can better serve industry to achieve greater earning power. This is No. 4 in the series.

2. *THIS DEVELOPMENT GROUP* produces such volumes as the one pictured above. Some four inches thick, it documents three years' development effort by Chemical Engineering in the field of heat exchange alone, which has resulted in improved design of Kellogg heat exchangers. Similarly, the group has worked out liquid-vapor equilibrium constants for hydrocarbon mixtures under all manner of conditions.



3. *ANOTHER VALUABLE CONTINUING STUDY* by the chemical development engineers concerns the "fluidynamics" of fractionating towers, pointing toward more efficient bubble towers of all types. These studies are constantly contributing to increased tower efficiency and may soon be responsible for the design of smaller bubble towers with as great or even greater throughput than the ones in current use.

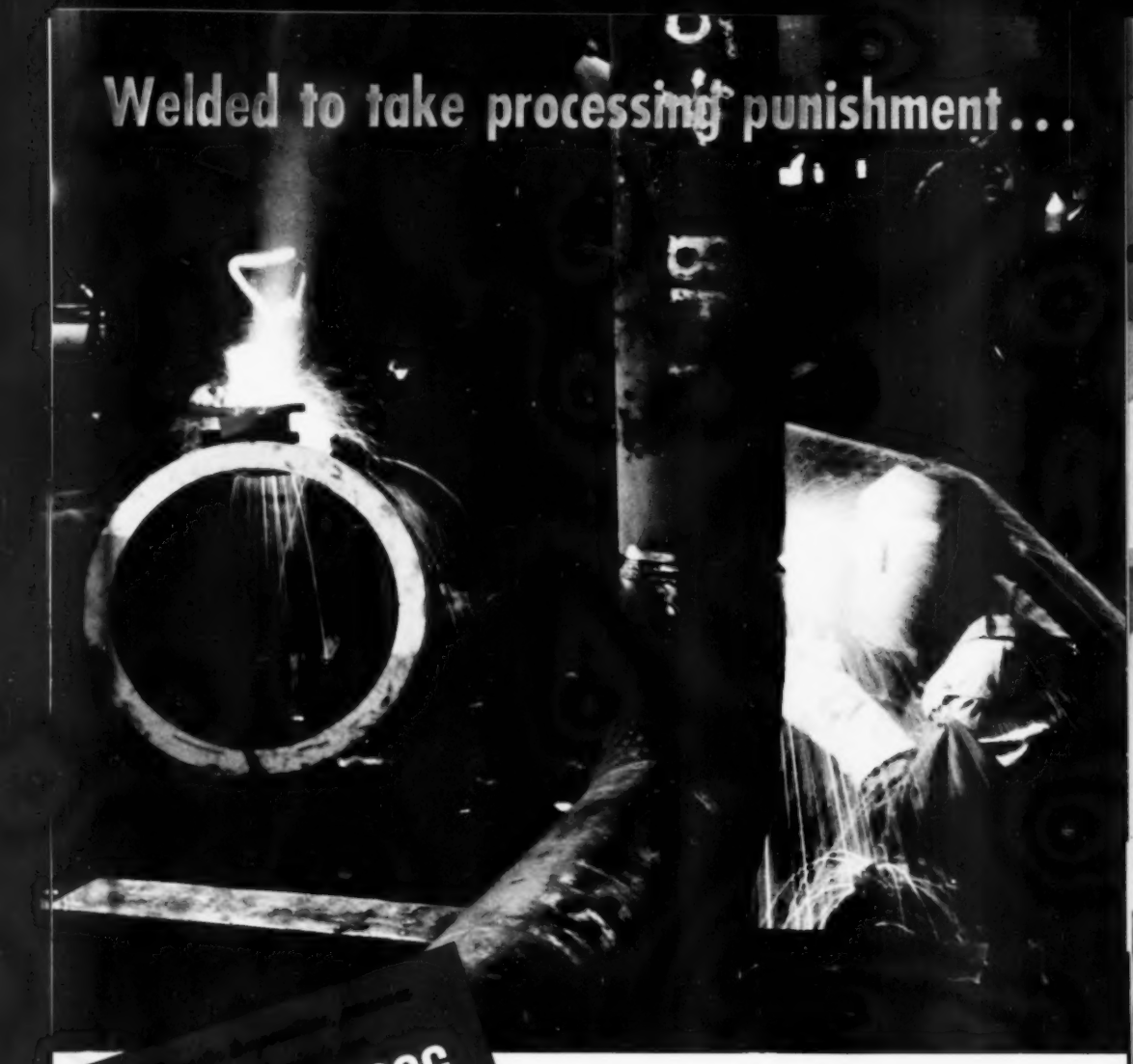
6. *THIS ECONOMICS GROUP* carries on general industry studies as well as individual studies of specific projects. Much of the stimulation of the development people for new processes comes from this group who constantly strive to perform processing functions at lower operating costs with smaller initial investments . . . and to obtain simultaneously improved yield and quality of products.



7. *BACK OF THESE* two groups are the *Process-Unit Engineers*—each group specializing in a particular process or type of processing. These engineers "live" with their particular process, devote their entire time to its improvement. These are the engineers who prepare for all Kellogg projects, the detailed process designs, flowsheets, etc., which are incorporated into Process Data Books, like the one shown here.

NEXT MONTH

. . . in the fifth in this series of camera studies of M. W. Kellogg today . . . you will see how Kellogg handles "Details by the Million" in the important phase of Design Engineering.



M. W. KELLOGG

For catalyst lines a man can walk through . . . for process piping that will exclude a mouse, Kellogg's exclusive fabricating techniques — bending, welding and stress relieving — produce piping that has appreciably longer service life in punishing process applications.

Pressure Vessels
Vacuum Vessels
Fractionating Columns
Drums and Shells
Heat Exchangers
Process Piping
Hi-pressure—Hi-temp Power Piping
Bends and Headers
Giant One-Piece Bends
Forged and Welded Fittings
Radial Brick Chimneys

Special Studies of unusual problems such as stress corrosion and graphitization to assure long life and low maintenance.

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Top Welding Performance in shops and in the field by welders accustomed to working under X-ray checks.

Metallurgical Research by recognized specialists who have made major contributions in this field.

Complete Facilities for the fabrication of steel products from simple forgings to specially cast bimetallic devices.

Quality Control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

NEWS FOR OPERATORS IN WESTERN CANADA!

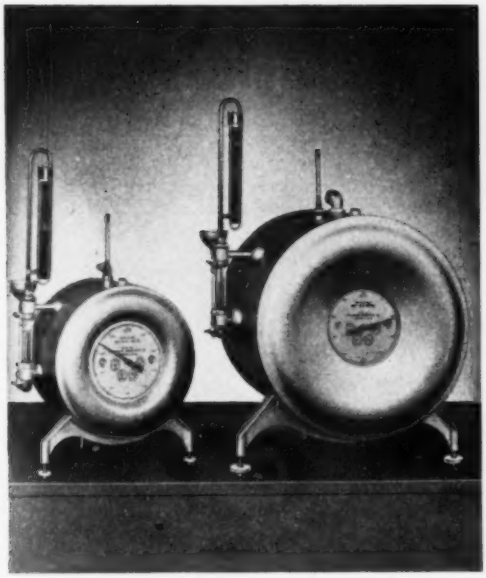
Canadian Kellogg Company has established complete shop facilities for the fabrication of all types of piping at EDMONTON in Alberta Province. Inquire directly or through any Kellogg office.

The M. W. Kellogg Company *(A Subsidiary of Pullman Incorporated)* New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris

For New ACCURACY with Laboratory Apparatus

—more precise, more certain—

Specify *Precision to be Sure



PRECISION Wet Test Gas-Flow Meters are *reliably* accurate within ½ of 1% under normal conditions, each *proved* against standard before shipment. Full-inch diam. gauge, built-in leveler, choice of contact metals, range of capacities. *Thousands* in constant use proving better, longer performance. Bulletin 7-110

PRECISION-Saybolt Viscometer (A.S.T.M. D88) gives greater accuracy by permitting full concentration by operator, freed from concern over "mechanics"; control to 0.05°F. Stainless steel exterior, fire-safe, continuous duty. Other models for different types heat, higher temperatures, etc. Bulletin 7-705

Among the 3,000 Precision products—"utility" items to highly specialized apparatus—are other instruments to make your work easier, surer, more economical. Probably some of your equipment warrants replacement, doubtless you can use additions . . .

ORDER FROM YOUR DEALER NOW!

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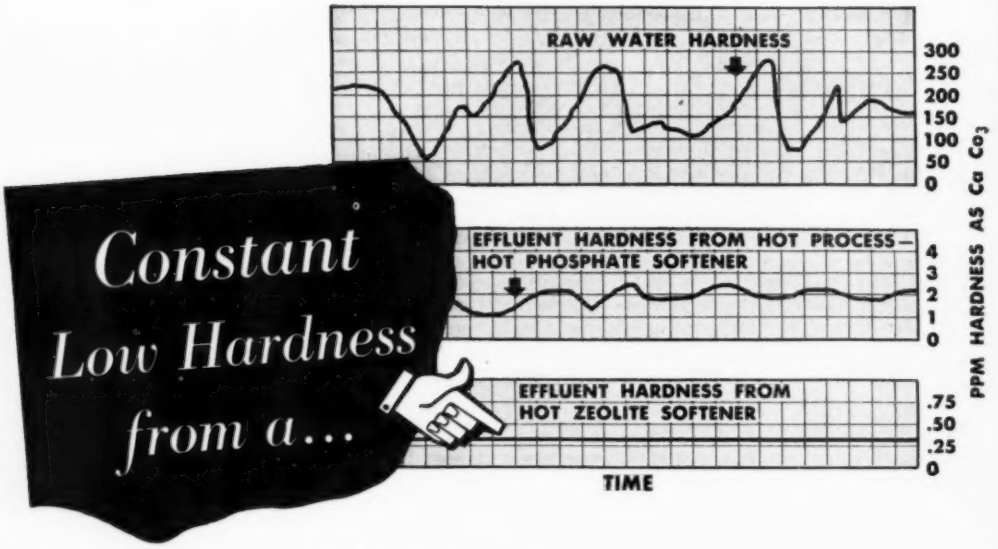


Constant Low Hardness from a...

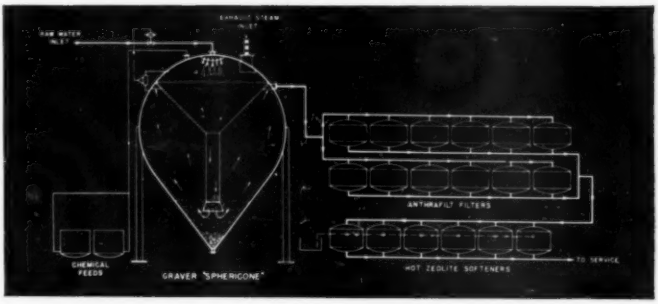
...Graver Hot Process Hot Zeolite Softener

Conventional lime-soda-phosphate hot process softeners effectively reduce raw water hardness. However, with extremely variable raw water supplies, chemical feeds must be adjusted to furnish precise quantities of chemicals in relation to raw water hardness and alkalinity in order to obtain suitable low hardness at all times.

The recent development of high-temperature resistant zeolites has provided a convenient solution to this problem. Substituting a second-stage hot-zeolite treatment, with Gravex styrene-base resin zeolite, instead of the more costly phosphate after-treatment, *constantly* low-hardness water is obtained *regardless* of sudden fluctuations in the initial hardness of the raw water . . . and at *lower cost.*

Therefore, if your raw water varies in source or hardness, be sure to investigate the Graver Hot Process — Hot Zeolite Softener. Graver engineers are available to discuss this process with you and compare its advantages over other processes at no obligation to you whatsoever.

Write for reprint of informative article on the features and benefits of hot zeolite softening.



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GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

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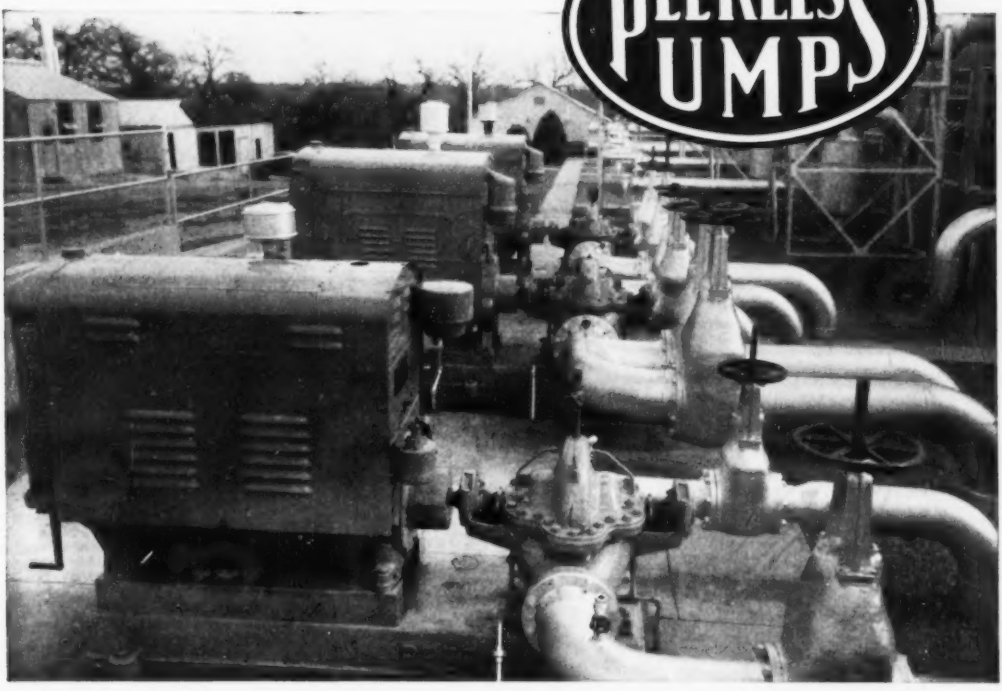
GR-437

PEERLESS PUMPS PREFERRED

VERSATILE CONTINUOUS-DUTY GENERAL PURPOSE TYPE A PEERLESS PUMPS



Peerless Type A Horizontal Centrifugal Pumps Used in Gas Booster Station for Handling Jacket Cooling Water

Peerless Type A general purpose horizontal centrifugal pumps are preferred by this large producer of natural gas, for a host of reasons. Here are a few of the features that contribute to their unsurpassed performance:

1. Employ duplex angular contact thrust bearings for longer life and lower maintenance cost, under heavy continuous or intermittent duty.
2. Bearing housings have double-wall construction; first, to insure against any distortion of ball race and second, to provide water-cooling space between walls.
3. Impeller rings are generously wide and grooved; efficiency is increased by minimizing leakage between suction and discharge chambers.
4. Heavy case rings, with ribs on both ends, provide extra strength, prevent distortion and effect a seal against leakage.
5. Shaft sleeves, locked against direction of rotation by right and left hand threads at impeller hub, prevent shaft distortion when handling hot liquids.
6. Incorporate five rows of heavy duty packing and utilize an in-and-out water seal connection for use when handling hot liquids.

These general purpose pumps are completely described in Peerless Bulletin B-1300. Write for your copy.

TYPE A PUMP CHARACTERISTICS

CAPACITIES: Up to 70,000 GPM
HEADS: Up to 300 Ft.
SIZES: 1¼" to 48"
LIQUID TEMPERATURES: Up to 300° F
SINGLE STAGE—DOUBLE SUCTION
HORIZONTAL SPLIT CASE

•

APPLICATIONS:

BOOSTER STATIONS
WATER SUPPLY
COMMERCIAL BUILDINGS
INDUSTRIAL PROCESSING
WASTE DISPOSAL
COOLING AND REFRIGERATION
FIRE PROTECTION

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
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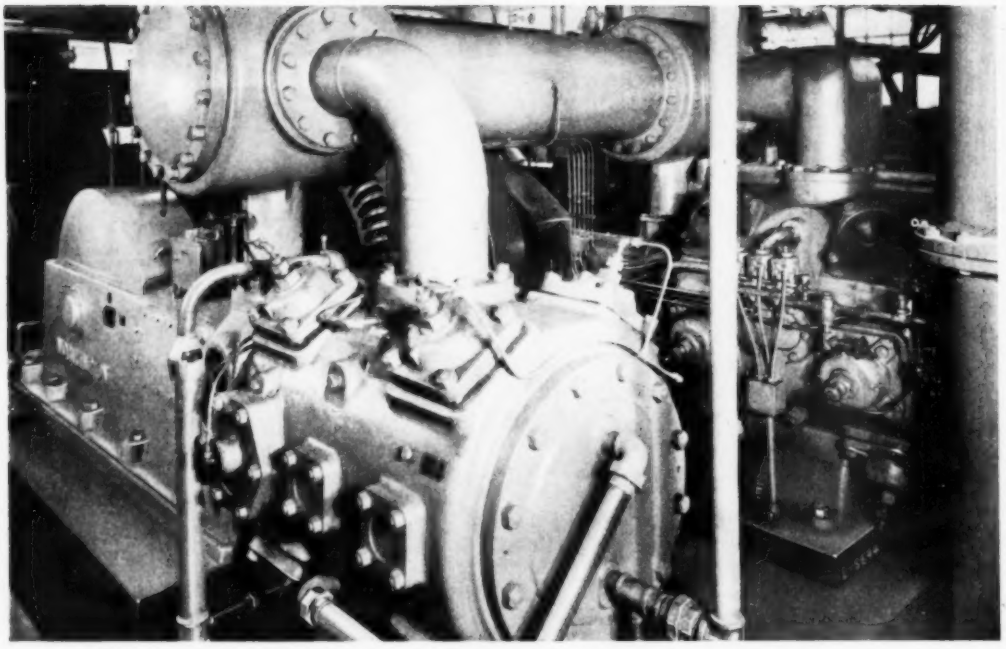

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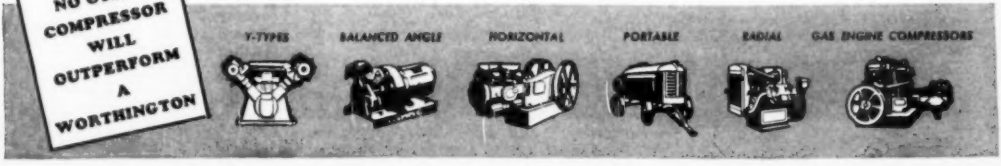
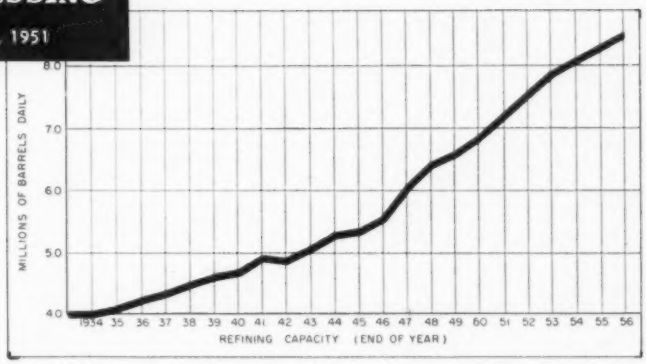




BASIC CAPACITY of U.S. refineries as seen by PAD

Capacity Must Be Expanded

PAD Study Sets Timetable for Expansion, 1,600,000 Bbls. During Next 6 Years

By BRUCE K. BROWN
Petroleum Administration for Defense

The following remarks by Mr. Brown, deputy administrator of PAD, are from a talk he gave before the Western Petroleum Refiners Assn. in San Antonio on April 4.

ACCORDING to the best figures available to me, the rated daily capacity of United States petroleum refineries just prior to the Korean invasion, was about 6,750,000 bbls. of crude oil and other raw materials. This figure may be compared with the daily capacity of 5,250,000 bbls. in July 1945, just before VJ Day. During the period between VJ Day and the Korean invasion, the daily capacity of the petroleum refineries of the United States had risen by a total of 1,500,000 bbls. This represented an average annual increase over the 5-year period of about 300,000 bbls.

Averages are always deceptive—let us look at the figures year by year. The increase in the war year 1945 was only 10,000 b/d. In 1946 when materials were still short and the future demand uncertain, the figure was 215,000 b/d. The industry undertook a great program of building up all sorts of facilities during 1947 and 1948 when product shortages occurred, and the figures for those years are 465,000 b/d and 400,000 b/d, respectively. In 1949 the refining business was none too good and the figure fell to 260,000 b/d. The first half of 1950 brought an increase of 150,000 b/d and by the end of 1950 national capacity had risen to 6,900,000 b/d.

It will be remembered that at the time the U. S. entered World War II, we had available in this country an excess of both producible crude and refining capacity. That excess was quickly absorbed by war needs and there has never been any substantial excess of refining capacity available since 1942.

History over many years indicates that our refining capacity has always at least kept pace with anticipated demand for petroleum products and that the crude oil has always been available to run in those refineries to the extent needed. In recent years, however, the U. S. has been confronted with a new situation. An increasing part of the normal demand for refining products has been supplied from foreign sources, either as foreign crude oil to be run in U. S. refineries or in the form of products refined abroad —mostly fuel oil. In recent months at least, the presently installed refining capacity of U. S. refineries has been pressed to supply the demand for products. The statistics indicate a decrease in the "shut down time." Shut down time has decreased to a point where one wonders whether the refiners have, any longer, adequate shut down periods in which to maintain and repair their units.

It is obviously "time" to build more refining capacity. After evaluating the upward trend of ordinary peacetime civilian demand plus the anticipated impacts of mobilization (not war) demand for military products, the Petroleum Administration for Defense has reached the conclusion that unless approximately 700,000 b/d of new capacity are added to the Nation's productive capacity by the end of 1952 the public may again be plagued with product shortages of the type that threatened in the immediate postwar period. *(Continued on next page)*

This is a most conservative estimate and allows nothing for the possible impacts of actual war—neither from the standpoint of increased demand nor from the standpoint of losses by sabotage or enemy action anywhere in the allied world.

Nor will it be possible to stop building after 1952. Peace or war, building will have to continue. By the end of 1953 the figure should exceed 1,000,000 b/d. By the end of 1956, it should exceed 1,600,000 b/d.

The expansion to which we refer is an increase in what we call "basic refining capacity," as distinguished from the capacity to produce products specially needed by the military such as aviation gasoline or other critically scarce products such as benzene. Basic refining capacity means capacity to take in crude oil and other raw materials and convert them into the usual petroleum products needed by the civilian population and by the military—such as fuel oils, kerosine, gasoline and the like.

The Oil and Gas Division of the Department of the Interior recently assigned to the National Petroleum Council the task of evaluating the cost in materials and money of creating an additional million barrels a day of producing capacity for crude oil and of refining capacity. While the work done by the National Petroleum Council Committee will be valauble to all concerned, that particular "million barrel study" has nothing to do directly with the program that I am discussing. The Oil and Gas Division wished to have reliable opinions from industry as to the material cost of creating an additional million barrels a day of petroleum from natural sources in order to compare those figures with estimates that had been made of the cost in materials and money of creating a million barrels a day of synthetic fuel capacity. The Council Committee, considering this million barrel a day problem, is considering it in increments and is evaluating the relative advantages and disadvantages of locating a part of that hypothetical crude production capacity and refining capacity outside the United States. That work should continue and, as I have stated, it will be a valuable part of the total information available to the Petroleum Administration. However, it bears no direct relationship to the figures I have been discussing. We do need to install a million barrels a day of additional basic refining capacity *in the United States* over the years 1951, 1952 and 1953.

You'll Play a Major Role in Mobilization If You're a 'Small Refiner'—and Here's Why

OPPORTUNITIES for the "small" refiners to expand and play a major role in the mobilization program are included in the planning of the Petroleum Administration for Defense.

PAD officials have stated in recent meetings with refiners over the country that the help of the small refiner is needed both in supplying the growing military product requirements, and in making up the million barrels of additional refining capacity in the U. S., need for which has been announced. This is almost a full about-face from conditions existing in the early days of World War II, when the outlook was bleak for the small refiner.

PAD's Refining Division Director Reid Brazell told refiners in his address before the Western Petroleum Refiners Assn. at San Antonio April 2-4, and reiterated it during the recent nationwide tour of PAD's self-styled "dog-and-pony troupe," that the small refiner has "a very important part in the smoothly-operating refinery program—the part that gives flexibility to the country's whole refining structure."

Because of the small refiner's plant size, he can quickly make changes in the products produced without causing any great disruption in his plant. The number of products he makes generally is small, so that only a short time is required for him to switch operations to things needed "the mostest and the fastest."

Also, the small refiner has the unquestionably deserved reputation of being highly ingenious in improvising when mechanical failures occur or plant disruptions are experienced. He usually goes further than his larger brother in salvaging materials, again because of his improvising genius and past experiences. Finally, the bulk of the independent plants are located inland, away from large industrial concentrations and the likelihood of aerial attacks.

Thus, one of the small refiners' roles in the mobilization program will be that of "shock troops," swinging quickly into new action while the more ponderous large plants get the needed time to change their operations to fit rapidly changing product requirement.

There are numerous ways for the small refiner to be of effective importance in the current program, as described by Mr. Brazell. It has been known since the early years of the last war that copolymer or unhydrogenated codimer may be as readily alkylated as the conventional "B-B cut." Studies made by Phillips Petroleum Co. on commercial HF alkylation equipment* indicate yields will not be reduced in charging full-scale co-polymer in conjunction with butane-butylene feed, nor will acid consumption be increased. Alkylate quality will at least be unchanged in comparison with that from "normal" feeds and may actually be improved. Also, propylenes and amylenes likewise may be substituted for B-B with some penalty in the quality of alkylate produced.

Most small refiners have "poly plants" and many of the independents have installed catalytic reformers and catalytic cracking units. Both of these latter processes increase the quantity of light ends in the refinery. Thereby the small refiner will be in a position to contribute substantially to alkylate production by making butylene polymer available to assure sufficient feed stock to keep alkylation units operating at their maximum capacity. Still another advantage from this program, already underway on the Gulf Coast where synthetic rubber plants compete for the butylene supply, is that the copolymer does not require pressure tank cars for shipment.

Catalytic reformers are of great interest to smaller refiners, it is apparent, and several new processes are available for use. The particular value of the reformers to the small refinery, and cycling plants, too, is that they have excellent peacetime possibilities, which unfortunately has not been true for small alkylation units. They make it possible for the small refiner without catalytic cracking to produce a high octane gasoline fully competitive in quality with those made by other processes. Research has disclosed that the high aromatic content of reformer gasoline may be used in high octane avgas to displace some of the alkylate otherwise required, thereby permitting an increase in avgas volume through the inclusion of more catalytic gasoline.

Another angle to the reformer possibilities is that, by prefractionating feed to a narrow boiling range cut, high purity aromatics of the "BTX" variety can be produced. Benzene, toluene and xylenes already are in

* Hydrofluoric Acid Alkylation, Chaps. 5, 6, and 12. The Phillips Petroleum Co. (1946)

short supply for chemical manufacture and such plants are slated to produce the desired 90 million gal. of petroleum benzene deemed necessary for defense needs. The demand for these fractions as chemical intermediates may be expected to carry over into peacetime as well as their usefulness as gasoline blending agents. The small refiner may be asked to fractionate the reformate, concentrating the aromatic portion for avgas use, or possibly consider extraction facilities for the same purpose.

Jet fuels are another product in which the smaller refiner may be expected to play an important part in the mobilization program. Extensive changes may be expected in the near future in jet fuel specifications, with more in the offing as further developments are made in the engines. The Reid vapor pressure of jet fuel, in a new JP-4 grade, is due to be cut to 2 or 3 lbs.; this automatically will require almost complete debutanizing of the gasoline component. The 50% point will be dropped to approximately 250° F., the end point lowered to 550° F. and a mercaptan sulfur limitation imposed for the first time.

Carbon deposits in the engines and storage stability problems may combine in future to favor low aromatics contents and perhaps require these fuels to be made exclusively from straight-run stocks. This will come, if present indications are substantiated that aromatics and olefins are the causes of carbon deposits and lack of storage stability encountered with present fuels.

Naturally, there remains to the small as well as the large refinery the necessity of supplying the increasing demand for civilian products, especially motor gasoline and home heating fuels, as well as Diesel and residual fuels for industrial use. The lead shortage may be expected to continue well into the first quarter of 1953, when present stockpile goals are scheduled to be met.

This is prefaced with the ominous "if"; that is, IF essential raw materials are available, IF the new facilities are completed as planned, and IF there is no great increase in gasoline demand. In any event, TEL stockpiles will take the first bite from whatever volume of tetraethyl lead is produced, next will come military needs, and civilian gasoline will get the remainder. Hence PAD's warning to refiners who use 90% of their TEL allocation in the first three quarters of the year; no more lead in such cases, and the clear prospect that, if anything, octane ratings generally will go down rather than remain stationary. Nothing was said about gasoline rationing.

Deputy PAD Bruce K. Brown also has made it clear that, in the immediate need for an expansion in basic refinery capacity of a minimum of 1,600,000 b/d by the end of 1956, the program will include the small refiner. This increase, he told WPRA members, is exclusive of facilities to produce special products having military importance but little peacetime value.

It is PAD's belief that most of the projected basic refinery capacity increase should come through the investment of private capital secured by normal means, rather than via "Government Plants" construction or "Defense Loans." To assure reasonable payouts for new construction in the face of rising corporate taxes developing from the mobilization program, PAD has and will continue to recommend issuance of certificates for "fast tax write-offs."

However, PAD wants refiners to use their own best judgment in locating new refining equipment and its necessary correlation with crude, transportation, manpower and market availabilities. "So long as the necessary basic refining capacity is constructed by private enterprise with its own money and its own legitimate borrowing capacity or credit, we can count on usual business prudence being exercised by such enterprises," Mr. Brown has stated.

In certifying tax amortizations, recommending loans and passing out priorities, he said each project is being screened by PAD from the standpoint of proper and prudent use of scarce construction materials whether or not it has special merit from the standpoint of national security in time of war.

In this connection Mr. Brown pointed out that, while we need more refining capacity and can use it in any reasonable location, we especially need a greater dispersal of refining facilities. Only when PAD is convinced that defense-type loans are needed to achieve full production goals of special products or that the required basic refinery capacity can be achieved in no other way, will such projects be recommended or authorized, he concluded.

API Sees U. S. Refinery Capacity up 3.9% in 1951

NEW YORK—Total operable refinery capacity in the U. S. is expected to increase 204,400 b/d or 3.9% during 1951, according to API's annual refining capacity survey. Capacity Dec. 31, 1950 totaled 6,856,950 b/d, and by Dec. 31, 1951 it is anticipated will reach 7,061,350 b/d. The table below gives a breakdown of these figures by refining districts and for the intervening quarters.

Figures for this year, however, do not include (1) projects approved to date by DPA which may be completed this year, (2) 126,000 b/d capacity shutdown as of Dec. 31, 1950, in need of major repairs, and (3) any bottleneck removal that may be accomplished as a result of the studies of the Refining Subcommittee of National Petroleum Council's "Million Barrel Committee." Figures do include about 147,000 b/d capacity shutdown on Dec. 31, 1950, which, while operable, is believed to be mainly high cost marginal capacity which probably would be used only in unusual circumstances.

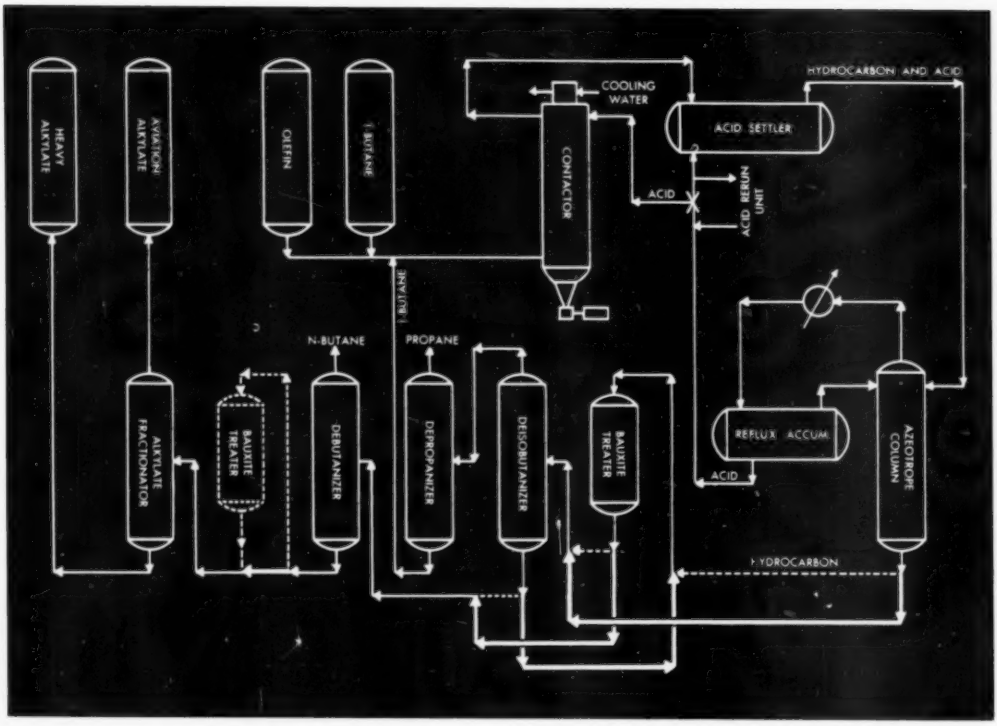
"For the country as a whole, figures include 473,000 bbls. of capacity as of Dec. 31 last, and anticipated as continuing at generally the same rate through 1951, that is represented by crude oil charged direct to cracking units. The areas in which this is carried on to the greatest extent are the East Coast, nearly 100,000 b/d, and the Gulf Coast, 275,000 b/d," report stated.

API later may revise figures for Sept. 30 and Dec. 31, 1951, as more information becomes available on progress of new construction and bottleneck removal.

U. S. Refining Capacity by Districts

Refining Districts	Dec. 31 1950 (1)	March 31 1951 (2)	June 30 1951 (3)	Sept. 30 1951 (4)	Dec. 31 1951 (5)	Operable Capacity Shutdown* (6)	Inoperable Capacity Shutdown** (7)
1. East Coast	1,021,700	1,046,700	1,046,700	1,056,700	1,056,700	.....	.....
Appalachian No. 1	113,750	115,750	115,750	115,750	115,750	.....	.....
2. Appalachian No. 2	75,300	78,300	78,300	87,300	87,300	.....	.....
Ind., Ill., Ky.	1,226,150	1,244,700	1,265,800	1,292,300	1,291,800	11,250	18,250
Okla., Kans., Mo.	573,200	579,200	585,700	586,200	600,400	11,250	19,250
3. Inland Texas	255,050	256,350	264,350	269,350	271,350	9,250	5,700
Texas Gulf	1,573,150	1,563,150	1,579,150	1,608,150	1,613,150	27,000	67,400
Louisiana Gulf	497,500	497,500	497,500	497,500	497,500	4,000	2,000
No. Louisiana-Arkansas	86,250	86,250	86,250	86,250	86,250	250	2,000
Rocky Mt.-New Mexico	16,150	16,850	17,050	19,550	19,550	.....	.....
4. Other Rocky Mountain	241,450	240,900	241,400	241,400	241,400	8,500	1,800
5. California	1,176,800	1,179,200	1,180,200	1,180,200	1,180,200	73,500	9,800
Total U. S.	6,856,950	6,904,850	6,958,150	7,040,650	7,061,350	147,000	126,200

* Operable capacity shutdown as of Dec. 31, 1950, included in cols. 1-5.
** Capacity shutdown and in need of major repairs as of Dec. 31, 1950, not included in cols. 1-6.



SCHEMATIC FLOW DIAGRAM for the HF alkylation process, showing changes in processing sequence. Broken lines indicate original sequence which has been replaced as indicated by the very heavy lines

HF Alkylation Today

New Equipment, Improved Operating and Maintenance Techniques Are Result of 8 Years' Experience

By D. P. THORNTON, Jr.
Southwestern Editor

EIGHT years' operating experience with hydrofluoric acid alkylation units has convinced Phillips Petroleum Co. there are no serious operating or corrosion problems associated with this method of producing high octane gasoline components. The process also can be used for commercial alkylation of propylene polymers from catalytic polymerization units as well as propylene and amylenes.

In the early days of HF alkylation plant operation, it was anticipated that serious difficulty might arise from both corrosion and personnel hazards, despite extensive pilot plant experience and research studies. But after eight years there have been relatively minor process changes, most of the equipment items and materials of construction listed are the same, and the likelihood of personnel injuries has been proven practically nil when proper precautions are observed. Considerable reduction has been effected in down-time for turnarounds because of the development of shortcuts and extensive use of detailed pre-planning.

Commercial operations have definitely proven that ordinary carbon steel is entirely adequate for most vessels, despite the bad reputation hydrofluoric acid had for viciously attacking most materials used in refinery practice. Where more than a trace of acid is found, low carbon steel or monel is recommended. Conventional materials are used where only traces of acid or hydrocarbon streams only are handled.

As one of its contributions to the war effort during World War II, Phillips made detailed reports available to operators of HF plants concerning operating procedures, corrosion rates experienced, and the effects of operating variables on alkylate production and quality. Test operation with various thermal B-B streams, mixed butylenes and amylenes, and with propylene also are presented. Originally published from 1942 to 1945 in the form of 17 so-called "Blue Books" on various phases of the subject, this information was consolidated in 1946 into a 366-page copyrighted volume entitled "Hydrofluoric Acid Alkylation." Approximately 600 copies of this book have been dis-

tributed to interested industry personnel.

Since the war Phillips has operated its Borger unit in a routine fashion and currently is readying another for operation in a subsidiary company's plant. It has continued technical consultation for the unit it erected for the Mexican Government. While many of the wartime units have been cannibalized, converted to other types of refinery processing or on standby status since 1946, it is probable that many which still are in condition to operate will be returned to service. Therefore the conclusions drawn by Phillips from this additional experience, not heretofore available in published form, are presented for those operating or contemplating the operation of HF units to meet increasing avgas demand. In this the information previously published is not repeated except in a few instances for reasons of emphasis.

The basic recommendations presented in the "Blue Books" have in the main withstood well the test of time. Experience has indicated as unnecessary many precautions at first deemed advisable in terms of auxiliary lines, certain treating facilities, extra block valves, valve types, some instruments and certain types of protective clothing. In general, both operating and maintenance procedures have been streamlined.

This does not mean that many precautions can be disregarded. But experience has proved, for instance, that the acid is not encountered in certain areas where formerly neutralizers were believed necessary. This equipment now has been dispensed with, or moved elsewhere in the process. Temperature-sensitive crayons—which indicate whether or not a given temperature has been reached by the appearance of the mark it leaves on the surface of the object—now are used to detect hot bearings instead of wiping with a clean rag before touching with the finger; this is a bit inconvenient but not nearly so much as an acid burn and there is no need to touch the hand to the bearing housing. Protective equipment still *must* be worn by operators and maintenance personnel—just in case—but normally eye shields and gloves are the usual requirement.

Plant Operation

There have been two principal changes in processing sequence from the original design shown schematically in the flowsheet. Originally, as will be noted by following the broken lines, bottom product from the azeotrope column, which removes dissolved acid overhead from the reaction mixture for return to process, was bauxite-treated ahead of the deisobutanizer. A second treating step occurred ahead of the alkylate fractionator.

In current operations, as indicated by the very heavy lines of the flowsheet, the reaction mixture is deisobutanized before defluorination. Experience with the azeo tower and analyses of the bottoms product showed that the small content of organic fluorides will not adversely affect the carbon-steel deisobutanizer and depropanizer. Since these fluorides will alkylate as readily as the olefins whence they are derived, they are returned to process with the isobutane bottom product of the depropanizer. A natural corollary is decreased bauxite consumption.

Similar analyses of the debutanizer bottoms (total alkylate make) showed negligible contamination with organic fluorides. In consequence the final bauxite treating step (broken line) has been eliminated as shown by the heavy line bypassing the treater ahead of the alkylate tower.

One of the early operating problems was silicon migration, resulting from the destruction of organic fluorides in the bauxite treaters and subsequent reaction of the fluorine with silicious impurities normally present in the natural material. Deposits in the form of silicon tetrafluoride plugged overhead condensers in the fractional system and also produced corrosion from hydrolysis (water is present because of formation in the defluorination reaction and from leaks) of SiF_4 to dilute hydrofluoric acid. Various remedies have been tried through the years.

Present practice calls for the addition of slacked lime, ranging from 5 to 15% by weight, to the bauxite to minimize silicon migration. Increased pressure drop when lime concentrations of 10 to 15% are used has forced the premature dumping of treaters on occasion, however. Caustic washing of treater effluent ahead of the fractionators also has proved helpful.

Formerly anhydrous ammonia was injected into the top of the deisobutanizer and the depropanizer for final tetrafluoride neutralization, but the practice now is to inject a solution containing a proprietary sodium phosphate type of water softener into the treater effluent ahead of the debutanizer and alkylate towers, the only ones now subject to this attack in consequence of treater rearrangements.

A particularly important point in successful operation is that the feed streams—olefin and fresh isobutane—must be dried before entering the acid section of the unit. While these streams obviously must be dry to avoid diluting the acid, and driers normally are provided for this purpose, the principal reasons for emphasis are that (1) the presence of water adds to the possibility of corrosion in the equipment and (2) the acid is a good desiccant. Moreover, all water admitted eventually must be disposed of as a 40% strength acid-water azeotropic mixture, with consequent increased operating costs.

Water concentrations not exceeding 2% are permissible as far as alkylate quality and organic fluoride content are concerned. However, above 5% water, the organic fluorides, alkylate deterioration and olefins in the alkylate becomes serious.

Equipment Changes

One of the principal changes in equipment used for HF alkylation has been the substitution of globe and gates valves for plug valves in sizes from 6-in. down. It has been found that monel-trimmed gate and globe valves, containing acid-type packing, perform very satisfactorily in hydrofluoric acid services.

The conventional stuffing box is used on globe and gate valves, being packed straight through with coreless aluminum foil packing. The lantern ring either is pushed down to the bottom of the stuffing box or removed. Experience indicates that lubrication is seldom if ever required, although a lubricant connection still is provided.

Standard types of 1-in. and smaller threaded valves are used which do not require a "special" order to the manufacturers but have a deeper stuffing box than normally supplied. Monel trim is necessary. Union bonnets usually are specified on the smaller valves to minimize bolting failures through stress corrosion or direct corrosion.

Even though temperature-pressure conditions do not demand it, 300-lb. ring-joint flanged fittings are specified for most acid services although normally the 150-lb. raised face design would suffice. This extra thickness is, therefore, a corrosion allowance. Welded fittings still are extensively used.

Pumping box difficulties involving all concentrations of acid have been reduced to a minimum. A flush liquid, isobutane or alkylate, depending on service, is introduced at the throat to prevent hydrofluoric acid from reaching the packing. Just behind the flushing liquid injection point, lubricating oil is introduced to "dam" against the isobutane and provide packing lubrication. Shredded copper packing, combined with plastic seal rings, complete the shaft sealing arrangement. Mechanical seals for this service are in the experimental-development stage. All packing is removed and destroyed when pumps are repacked.

The original type of packed stuffing box mentioned in the "Blue Books", oil lubricated and flushed with the appropriate service liquid, is used in the smaller pumps. Monel shafts and impellers have been found most satisfactory in dilute acid serv-

GENERAL VIEW of the HF alkylation unit at Phillips Petroleum Co.'s Borger, Texas, refinery. Hydrocarbon area is at left, segregated from acid area at right. Two large towers are deisobutanizer and debutanizer

ices where corrosive conditions are most severe. Where little acid is anticipated carbon steel may be used.

Several changes have been made in mechanical seals and heat exchanger bundles for the Stratco contactors. The bundles originally supplied were "scabbard and saber" type with finned tubes. Bundles now are fabricated with plain, unfinned carbon steel tubes and are hairpin design.

The double mechanical seals in the contactors were found more satisfactory at Phillips' Borger refinery than at its Kansas City plant. At Borger the upper seals were steel, the stationary element Colmonoy-faced and the rotating element Stellite-faced. The bottom seals were Stellite-faced steel for the rotating element and a lead bronze stationary piece. At Kansas City both stationary elements were lead bronze, rotating elements Stellite-faced steel.

The Colmonoy facing for the upper stationary element, the one most likely to encounter acid, or acid-hydrocarbon mixtures, requires careful workmanship to avoid exposure of the base metal. The most satisfactory procedure has been to arc-weld the first layer to the steel base metal, then true up. A second layer of Colmonoy then is applied with an acetylene torch. The face is again trued and lapped-in as customary. This type of facing is easily repaired

Special precautions to secure 100% face-to-face contact at the metal seals are advisable. Mechanical checking of the Dura-seals in recommended, especially in-place alignment. If necessary, the wearing surfaces should be refaced in place to assure true contact.

The original azeotropic distillation towers installed at plants for which Phillips was a consultant had steel internals. The Borger tower is 49 ft. high and then contained 20 trays. Inspection here disclosed little corrosion attributable to the acid. This finding, along with the low fluoride content of the kettle product, ultimately was responsible for the decision to locate the bauxite treaters downstream of the deisobutanizer described earlier.

Refluxing the azeo tower with hydrocarbon-phase settlings from the overhead accumulator was discontinued long ago, after considerable trouble was experienced from occasional slugs of acid being carried over with the hydrocarbon. The entire overhead, after condensation, now is sent directly back to the contactors. To minimize the loss of hydrofluoric acid as combined fluorides in the product streams, catalytic defluorination is practiced in the azeo tower. This has been accomplished by replacing some of the original trays with a packed section of 1-in. carbon Raschig rings.

The old style acid rerun unit has been replaced with a new unit, employing isobutane stripping which thus eliminates the need for reboiling in the acid-oil leg. Accumulated water leaves the system via the acid-oil leg.

In order to minimize potential danger from the type of corrosive attack known as "hydrogen blistering," Phillips now specifies a high quality, clean carbon steel, free of pockets, slag inclusions and laminations. The apparent cause of the "blistering", which is not peculiar to hydrofluoric acid alkylation equipment, is the migration of hydrogen into the metal, the hydrogen being a product of slow corrosion.

The hydrogen accumulates in any suitable point in the steel, building

up pressure and forming a "blister." It is known that other oil companies, which also have found this type of attack in various kinds of process equipment, are actively seeking the answer to hydrogen blistering by attempting to determine what other factors may be involved in addition to hydrogen-liberating corrosives (i.e., metal structure, possible catalytic agents in metal or corrosive agent, pressures, temperatures, flow rates, contact time and cyclic changes).*

For this small area of the plant, heat exchanger bundles now are monel tubed in a hairpin design. The tubesheets are double, the acid side being a thin sheet of monel. In this connection it is believed that a monel-clad tubesheet, rather than two separate sheets, should be equally satisfactory and probably mechanically simpler to maintain.

Monel now is used for flange bolting generally throughout the acid section of the plant. Torque wrenches set to the maximum allowable bolt stress are used in order to eliminate the possibility of stress corrosion failures due to excessive strains in the bolting when making up the flange. Monel trim is specified on all valves exposed to acid. Two commonly used brands of lubricants have been found satisfactory for plug valves. It is not now the practice to move valves during each shift or day.

Only minor changes have been made in control instrument equipment. The principal alteration has been the substitution of a "Gagetron" (See PETROLEUM PROCESSING, pp. 941-45, Sept., 1950) as a level controller in the acid flash tower acid-oil leg. Formerly a torsion-tube volumetric displacement type level controller was used. The Gagetron electronically measures variations in gamma ray intensity resulting from variable thicknesses (depth) of liquid intervening between radium source and measuring device.

Originally, silver-plated diaphragms were used on volumetric type pressure control equipment. The rule now is to use the less expensive monel, which gives equally satisfactory results. Monel bellows are used as seals in relief valves to confine vapors to the nozzle and disc, which parts are monel trimmed. All other parts of the valve are conventional materials.

Maintenance Techniques

A major though quite simple improvement in maintenance techniques alone saves a minimum of one-day's time during major turn-arounds, presently scheduled annually. The improvement consists of washing out all vessels and lines in acid or acid-hydrocarbon service in one operation rather than individually as in the past. (An early time-saver was the incorporation of connections to permit acid-treating of the water-side of cooler bundles throughout the plant while in full operation.)

Procedure calls for all such vessels, after routine pump-out and purging, to be washed with a neutralizing solution and then water before men are allowed to enter. The cooling water pumps serving the unit, of low-head high-capacity design, have been adapted to this purpose by suitable arrangements in piping. The neutralizing agent, usually soda ash, is added at the pump suction and the pump discharge is switched to the hydrocarbon or acid lines at the unit instead of following the usual path.

With this provision, one vessel after another can be quickly neutralized in normal flow sequence. Since the solution is only weakly alkaline and its fluoride content likewise low it is dumped directly into the surface water disposal system without special treatment of any kind.

Turnaround procedure now used is quite similar to that of any major refinery unit. The date is scheduled long in advance and worksheets made up covering the anticipated jobs by individual areas. Each job carries a priority and indication of when it can be performed. The worksheets are blue-printed for distribution and serve as work orders. Accurate records are kept as work progresses. As time permits, all work possible is done on the unit ahead of time and the necessary items for the work are ordered in sufficient time to make sure they are ready for use.

When the unit actually comes down, intensive work is performed only on the minimum of equipment needed for the start-up. The rest is blocked off with suitable valves so that the spare and non-vital auxiliary equipment, not inspected or repaired during the pre-shutdown program, may receive attention after the unit has been returned to operation. Simplicity is stressed and very little in the way of special expediters and coordinators is required. Yet the status of any job on the unit may be readily ascertained at any time during the turnaround.

In this connection an extensive program of built-in equipment—trolleys, cranes, davits, booms and platforms—has been performed to minimize the need for temporary, time-consuming rigging. Large vats are made available at the units, filled with soda-ash solution, for the neutralization of instruments, valves, pumps and small parts before sending them to shops for repair. The external surfaces of electric motors and other electrical equipment (of vapor-proof construction because of the effect hydrofluoric acid has on copper) which might be acid-contaminated also are neutralized.

The current status of maintenance operations at Borger requires six to seven days downtime for turnaround. This is more or less the average for the past several years. In the plant, a considerable amount of additions—such as built-in handling facilities, experimental equipment and the like—have been included in the turnaround work load. The amount of additional work, above the ordinary maintenance requirements, is diminishing. The lighter work load, plus continual improvement in planning and methods, undoubtedly will result in less time requirement for future turnarounds.

Safety Record

The record for safety over the years the Borger unit has been in operation is good for any type of refinery unit. There never has been a fatality, only five or six lost-time injuries without permanent disability, and not even a skin burn in the past two years. At no time have personnel been trapped in HF vapors and there have been no accidents where eyes or ears were involved.

Several measures are responsible for the very low accident frequency. When the unit was started, men were told the facts about HF dangers and what to do about them in such a manner that they were not "scared to death" but did build up a healthy respect for it.

They were told, for instance, to be liberal in using "alkaline-acid test paper" (essentially litmus) to check for dangerous liquids, and temperature-sensitive crayons of the proper range to determine if bearings were running hot.

Other measures not mentioned in the Blue Books include:

Thermostatically controlled vats containing aqueous sodium bicarbonate are located conveniently to equipment for immersing any body parts which might have contacted acid.

A commercial lanolin-base protective cream is provided to protect the exposed parts of the body from acid vapors. Individuals with fair, sensitive skins are especially urged to use it.

Men working in the acid area have toilets and change house separate from men in the hydrocarbon area.

For Class "A" work, only the plastic face shield and rubber gloves are used; supervisory employees may wear plastic monogoggles. The use of an apron for Class "B" work has been abandoned in favor of a rubber overall-and-jumper. Class "C" clothing is used for major work of all kinds. While Class "D" (complete body and respiratory protection) clothing is provided against an emergency, it never has been used.

* For a further discussion of hydrogen blistering, see p. 501 of this issue, where a portion of the paper "Hydrogen Attack of Steel in Refinery Equipment" presented at the recent API Refining Division meeting in Tulsa is presented.—Ed.

COLOR REDUCTION OF 98% from process water (left) to plant effluent (right). Center sample is blend of process and storm waters

Treating Refinery Chemical Waste

New methods have been developed for treating waste water containing chemicals in solution

By HANS SCHINDLER
L. Sonneborn Sons, Inc.

This paper was presented originally by the author at the 16th Mid-Year Meeting of the API Division of Refining, Tulsa, May 1, under the title "Chemical Treating Plant for Refinery Waste Water."

WITH the greater emphasis on chemical processing in the petroleum industry, the problems of waste water disposal have changed in character. Special treating methods have had to be devised for those effluents which are not merely suspensions of oil in water, but which contain chemicals in solution.

The manufacture of medicinal and technical white oils, with its attendant production of petroleum sulfonates, is both a petroleum refining and chemical processing operation. The waste disposal methods of a plant specializing in these processes should be of interest to the industry as a whole. Such a plant is the Daugherty Refinery Division of L. Sonneborn Sons, Inc. In this plant, all waste waters containing water-soluble contaminants are treated together. Waste water containing only suspended oil is kept completely separate, and is very successfully treated in an API separator.

Source of Waste Water

White oil manufacture consists principally of the exhaustive treatment of suitable petroleum fractions with fuming sulfuric acid, with the result that the finished product is free from colored compounds as well as those able to react with sulfuric acid. The products of the interaction of reactive hydrocarbons with sulfuric acid are alkylated aromatic sulfonates which, depending on their structure, remain dissolved in the oil or which separate from the treated oil, together with polymerized hydrocarbons and spent acid in the form of acid sludge. The oil-soluble sulfonates are recovered from the treated oil, and are purified for sale as a valuable petroleum chemical. The acid-treated oil is finished by neutralization with caustic.

At the Daugherty Refinery, acid sludge does not represent a source of pollution because the sludge is converted into sulfuric acid and coke. This is accomplished by decomposing the sludge into sulfur dioxide and coke, followed by oxidation of sulfur dioxide to sulfuric acid in a conventional contact acid plant.

The gas produced in the decomposition step is cooled by direct contact with water, and this cooling water is continuously discharged from the unit. It cannot be directly admitted into the stream because it contains a certain amount of dissolved sulfur dioxide, and has an acidity corresponding to 0.1 to 0.2% sulfuric acid. The volume of this cooling water from the sludge-conversion plant is such that it represents the largest component of the waste waters requiring chemical treatment.

The other source of waste water containing dissolved chemicals is represented by the white-oil plant. Whereas the bulk of the water-soluble sulfonates occurs in the acid sludge and presents no disposal problem, the waste water from the manufacture of white oils and from the recovery and purification of petro-

leum sulfonates cannot be kept completely free from these compounds because of unavoidable spills and because of the need for periodic cleaning of equipment as well as for operational reasons.

The process waste water, therefore, is colored, acidic, or alkaline, and it contains water-soluble sulfonic acids and sometimes emulsified oil.

Waste-Water Treating Process

Two types of waste water requiring chemical treatment are produced: (1) water containing sulfur dioxide which originates at the sludge-conversion plant; and (2) acidic or alkaline process waste water containing water-soluble petroleum sulfonates which originate at the white oil and petroleum sulfonate plants. After extensive laboratory and pilot-plant work[1] a procedure was developed which combines the disposal of both wastes in a simple and economical way. The procedure is based on the finding that the process waste water can be decolorized by converting the water-soluble sulfonates into the insoluble calcium salts, and that this reaction can only be successfully completed if the free sulfonic acids, rather than the corresponding salts, are reacted with lime. On this basis the following method was found most advantageous, because it combines the chemical requirements of the process-water disposal with the purification of the sludge-conversion plant waste water:

1—Adjustment of process waste water to a pH of 5 by mixing with acidic water from sludge-conversion plant.

2—Precipitation of sulfonic acids and mineral acid with hydrated lime at a pH of 7.0 to 8.4.

3—Continuous settling of precipitate and discharge of treated water.

The small-scale results with this procedure were so encouraging that it was decided to use it full-scale, and a complete plant was designed by Morris Knowles, Inc., Pittsburgh. The heavy construction work, including all concrete work, was carried out by a contractor; and the equipment was installed by the refinery staff.

Collecting System and Treating Plant

Waste water originating in the white-oil manufacturing process is conducted through tile sewers which have been made tight with acid-proof cement, to a concrete sump of about 3,750-gal. capacity, from where it is pumped through a 4-in. line to a 50,000-gal. waste-water holding tank located near the treating plant. The sump is equipped with a vertical, centrifugal-type, bronze-fitted sump pump, with a capacity of 200 gpm. and, for emergencies, a steam pump of about the same capacity. The waste water from the purification of petroleum sulfonates is collected in a sump which holds about 2,000 gal, and is pumped into the same waste-water holding tank as the white-oil process waste water. The same line is also used for both waste waters. The volume of the combined waste amounts to an average of 50,000 gal./day.

Originally, Transite pipe was used for handling the process waste water because steel had been found unsuitable in a temporary waste-water treating installation. However, inspection of the Transite pipe after only a few months' service indicated severe corrosion; therefore, use of this construction material for the type of

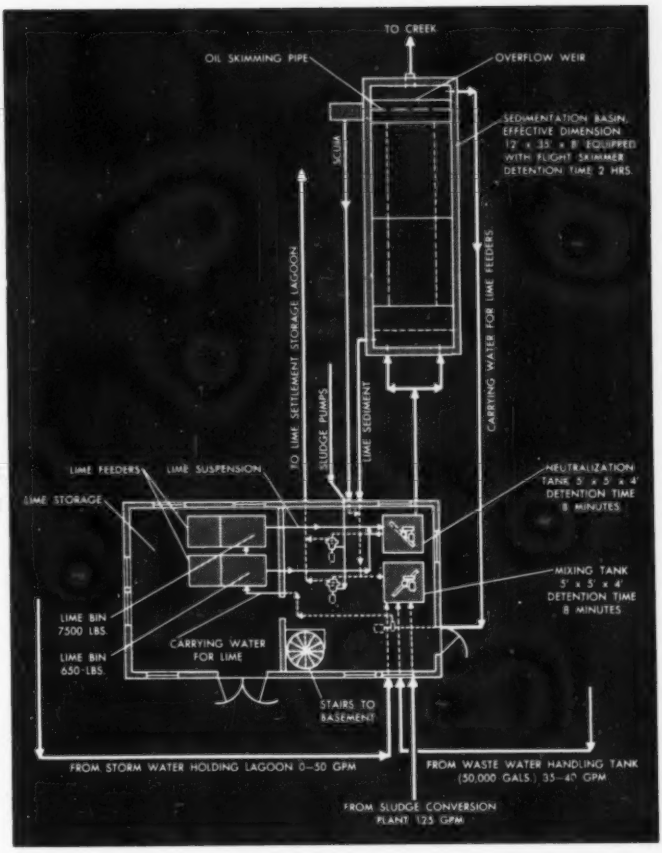

TO CREEK
OIL SKIMMING PIPE
OVERFLOW WEIR
SEDIMENTATION BASIN, EFFECTIVE DIMENSION 12' x 35' x 8' EQUIPPED WITH FLIGHT SKIMMER DETENTION TIME 2 HRS.
SCUM
TO LIME SETTLEMENT STORAGE LAGOON
SLUDGE PUMPS
LIME SEDIMENT
CARRYING WATER FOR LIME FEEDERS
LIME FEEDERS
LIME SUSPENSION
LIME STORAGE
NEUTRALIZATION TANK 5' x 5' x 4' DETENTION TIME 8 MINUTES
MIXING TANK 5' x 5' x 4' DETENTION TIME 8 MINUTES
LIME BIN 7500 LBS.
LIME BIN 650 LBS.
CARRYING WATER FOR LIME
STAIRS TO BASEMENT
FROM STORM WATER HOLDING LAGOON 0–50 GPM
FROM WASTE WATER HANDLING TANK (50,000 GALS.) 35–40 GPM
FROM SLUDGE CONVERSION PLANT 125 GPM

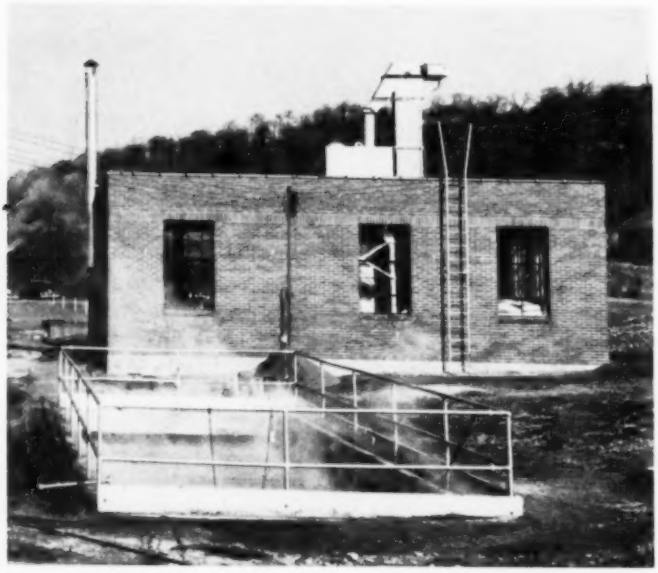
FIG. 1—SCHEMATIC LAYOUT and flow diagram of chemical treating plant

because steel had been found unsuitable in a temporary waste-water treating installation. However, inspection of the Transite pipe after only a few months' service indicated severe corrosion; therefore, use of this construction material for the type of

Meet the Author

Dr. Schindler

Hans Schindler, a native of Vienna, Austria, received his technical education in Munich and Berlin, Germany, and at the University of Prague, Czechoslovakia, where he was granted a doctor of science degree in 1934. After working for Oelwerke Julius Schindler, Hamburg, a large German white-oil manufacturer, he came to this country in 1938 and joined Pure Oil Co. in research and development. He remained with Pure until 1946, except for the greater part of 1945 when he served as a member of the Technical Oil Mission investigating German petroleum and synthetic oil industry. In 1946, Dr. Schindler became associated with L. Sonneborn Sons, Inc., at the Daugherty refinery, Petrolia, Penna.



GENERAL VIEW of treating plant: sedimentation basin in foreground with storage and chemical treating equipment in building behind it

process waste water encountered at the Daugherty Refinery cannot be continued. The unpredictable change of alkalinity, acidity, oil content, salt concentration, etc.—aggravated by occasional elevated temperatures and the presence of abrasive material, such as clay—makes selection of an adequate piping material very difficult. Bronze has given satisfactory service in pumps and valves.

Although it is attempted to collect process waste water at its source and thereby keep to a minimum the volume of water requiring chemical treatment, it is not possible to eliminate completely spills or to avoid contact of storm water with areas impregnated with sludge and similar wastes. For this reason a certain amount of storm water had to be included in the waste-water collecting system. This water is collected in a sump equipped with two vertical centrifugal sewage pumps, with a capacity of 1,400 gpm. each, and is pumped through a 16-in. standard cast-iron line to a holding basin with a capacity of about 55,000 gal. The accumulated storm water is treated together with the other waste waters.

The acidic waste water from the sludge-conversion plant — which amounts to 180,000 gal./day of acidic water with a temperature of 180° F —is run by gravity through a 4-in. rubber-lined steel pipe directly to the treating plant. In this way all unnecessary handling of this very corrosive water is avoided. The properties of the waste waters and their volume are summarized in Table 1. A flow diagram for the process is given in Fig. 1.

Mixing of the waste waters is carried out in a square concrete tank, 5 ft. square and 4 ft. deep, lined with acid-resistant brick. The acidic mixture continuously overflows into an identical concrete tank, where it is mixed with hydrated lime suspended in a small amount of carrier water. The retention time in each of the tanks is 8 min. Agitation is provided by mixers manufactured by Walker Process Equipment, Inc. The speed of the stirrer in the mixing tank is 600 rpm, whereas that of the stirrer in the neutralizing tank is 300 rpm. The treating tanks are covered; and a fume duct, made of 6-in. spiral pipe, has been found adequate for the removal of sulfur dioxide fumes.

Regulation of the treating operation is twofold: (1) control of the volume of process waste and storm water added to the constant flow of acidic waste water; and (2) control of the amount of lime added. The flow rate of the process waste water from the holding tank to the treating plant is regulated by means of an automatic float valve which is operated in conjunction with an indicating flow meter. The flow of storm water from the basin is controlled manually.

Hydrated lime is applied to the acidic waste water by means of two automatic lime feeders. Only one of the feeders is normally operated; the second one serves as a standby.

In order to conserve water, treated effluent is used as carrier water for the lime feeders. The water is pumped to the lime feeders with a 15 gpm. bronze turbine-type pump, and its temperature is maintained at 80° F. by mixing with a small amount of

TABLE 1—Properties and Volume of Waste Water

Source of Waste Water	Temp. (° F.)	Properties	Volume (Gal./Day)	Feed Rate to Treating Plant (Gal./Min.)
Process water from white-oil and petroleum-sulfonate plant	60 to 150	Alkaline or acidic; contains salts, water-soluble sulfonates, and emulsified oil	18,000 to 40,000	35
Water from direct cooling of gases from sludge-conversion plant	180	Acidic (dissolved sulfur dioxide equivalent to 0.1 to 0.2% sulfuric acid)	180,000	125
Storm water	60 to 80	Slightly acidic	.....	40 (max.)

TABLE 2—Operating Data of Waste-Water Treating Plant

	Process Waste Water						Water Treated					Properties of Effluent	
Month	Frequency of Acidic Reaction (Days)	Average Acidity (PPM of Sulfuric Acid)	Frequency of Alkaline Reaction (Days)	Alkalinity (PPM of Sodium Hydroxide)	Composite Sample Color (PPM)	Composite Sample Oxygen Consumed (PPM)	Process Waste Water (Gallons)	Total Waste Water (Gallons)	Acidity of Mixed Waste Water (PPM of Sulfuric Acid)	Lime Used (Tons)	pH	Color (PPM)	Oxygen Consumed (PPM)
June, 1950	16	983	14	1,950	1,700	518	1,678,264	7,413,264	1,360	55.3	7.5	30	42
July, 1950	16	2,180	15	1,275	5,100	760	1,718,496	7,551,496	1,600	54.1	7.0	45	50
August, 1950	19	785	12	440	2,150	460	1,505,796	7,305,796	1,325	50.4	7.0	45	37
September, 1950	23	1,365	7	314	5,000	545	1,396,400	7,115,384	1,435	54.7	7.0	60	35
October, 1950	17	674	14	515	3,160	535	1,387,540	7,027,540	1,330	52.3	7.0	65	40
November, 1950	16	586	14	1,010	2,600	623	1,380,040	7,220,040	1,150	44.5	7.0	50	40

well water through a thermostatically controlled valve. Control of the carrier-water temperature avoids any difficulty with feeding damp lime, which occurs when the effluent is hot.

The treated water continuously overflows into a rectangular settling basin (effective dimensions: 12 ft. x 35 ft. x 8 ft.), equipped with a sludge collector of the flight skimmer type. The retention time in the settling basin at the design flow of 200 gpm. is 2 hrs. Scum and oil which collect on the surface are removed by a hand-operated skimmer pipe which conducts the scum and oil to a collecting pit. The lime sediment and the oil and scum are pumped to a lagoon by means of a 50 gpm. centrifugal sludge pump located in the basement of the building which houses the treating equipment. A second identical pump serves as a standby. Free water which collects on the surface of the lime-sediment lagoon overflows into the storm-water basin, from where it is returned to the treating plant. The entire mechanical equipment for the treating plant was made by Walker Process Equipment, Inc.

Operation and Results

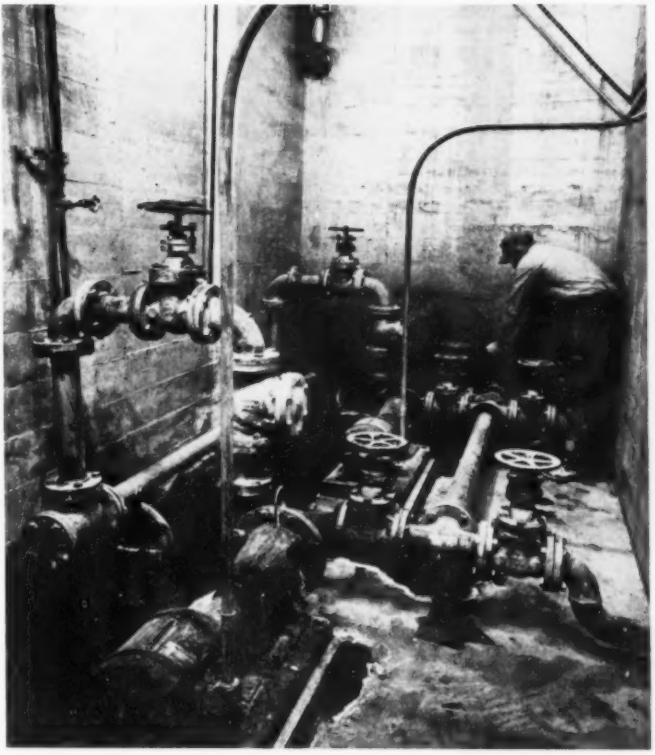
The waste-water treating plant was started in February 1950, and has operated satisfactorily from the beginning. The operating data given in Table 2 cover six representative months.

Because of the fluctuation in the properties of the process waste water, the periods during which it was alkaline or acidic, as well as the periods of concentration of acid and alkali, have been listed separately in Table 2. This should give a somewhat better picture of the operations than a single figure for the average reaction of a composite monthly sample, inasmuch as the waste water is usually uniform during each 24-hr. period.

On the other hand, color and oxygen consumed, to a certain extent, are independent of the reaction of the water and, consequently, in this case the information provided by a composite sample should be adequate.

It will be noted that the lime consumption does not run parallel with the acidity of the mixed waste waters. The reason for this is that lime consumption, to a considerable extent, is dependent on the sulfonate concentration; i.e., the color of the waste water and the need for lime for precipitating the sulfonates and for reducing the color are indicated by the correlation of color of the process waste water and lime consumption. In all cases the color reduction is not less than 98%.

Usually, addition of an amount of lime to give a pH of 7 in the neutralizing tank is sufficient to obtain a lime precipitate which will settle rapidly. However, in some cases—especially at high concentrations of sulfonates in the water—it is necessary to raise the pH to 8.4. An excess of lime above that required for neutralization is also useful in case of a large amount of emulsified oil, inasmuch as the heavier precipitate absorbs the oil.



TRANSFER PUMPS for moving lime sludge from settling basin to lagoon

The fact that the waste-water properties are usually uniform for about 24 hrs makes it possible to operate the plant with only one full-time operator, for the reason that the control setting made at the end of the day shift usually needs only minor adjustments during the following 16 hrs.

In order to make this operating schedule possible, it was necessary to increase the hopper capacity to 7,500 lb. of one of the lime feeders from the original capacity of 650 lb. With the increased hopper capacity, the full-time operator can fill the lime feeder and make the necessary settings so that the part-time operators only need to check the effluent quality and make minor changes in the lime-feed rate.

No unusual operating difficulties have been encountered thus far. As is usual for a system which handles lime or a lime precipitate in suspension, it is necessary periodically to clean the lines which carry these suspensions, but the operators have found that this can be accomplished easily by steam (if necessary, under pressure) instead of by rodding.

It should be noted that the volume of waste water listed as "plant throughput" in Table 2 does not include any dilution by storm water except for the November data, inasmuch as the storm-water pumping station was only completed in the last part of October 1950. However, the data do include an average of 282,000 gal./month of storm-water runoff from an abandoned acid-sludge pond. Addition of the regular plant storm water—because of its low concentration of sulfonates, acid, caustic, and similar—somewhat improves operations because this additional water acts as a diluent for the much more highly contaminated process water.

References

(1) "Disposal of Refinery Waste Water Containing Water-Soluble Sulfonates," H. Schindler, *Petroleum Refiner*, Vol. 28, No. 10, p. 152; October, 1949.

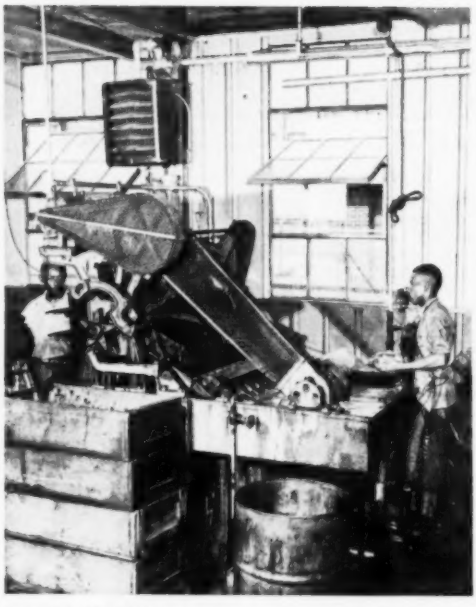
PAD 'Dog and Pony Troupe' on Tour

TOP OFFICIALS of the Petroleum Administration for Defense made a quick cross-country tour the week of April 9 and held open meetings at Houston, Los Angeles, Denver, Chicago and New York to discuss oil's problems. Shown here at the Chicago meeting are T. L. Apjohn, assistant director of refining division; A. P. Frame, assistant deputy administrator, domestic operations; and Reid Brazell, refining division director.

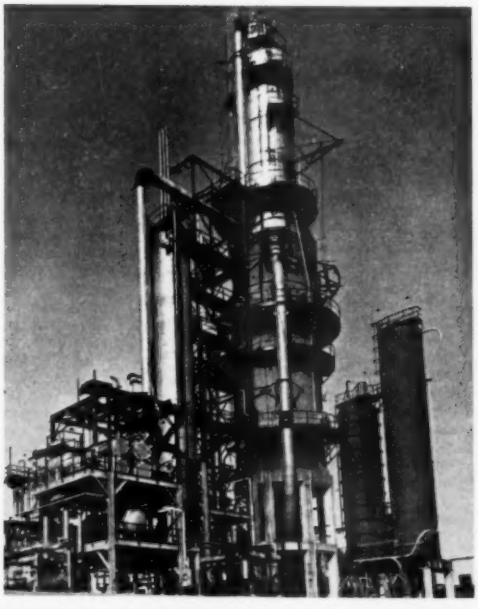
Apjohn discussed the avgas supply situation, described as adequate on a short-term basis, but not so good on a long-term outlook; the need for more alkylation capacity; and the shortage of sulfur and sulfuric acid.

Brazell warned that TEL supplies would continue tight until stockpile goals are reached—probably the first quarter of 1953, and that refiners now using up their TEL quotas and counting on additional allocations later in the year are doomed to disappointment.

Frame acted at master of ceremonies of the self-styled "dog and pony troupe." Over 1200 persons attended the five meetings.



BOTTLE-WASHING is on a mass-production basis at the Marcus Hook, Pa., refinery of Sun Oil Co. This five-man bottle-cleaning department collects, washes and returns to service all sample bottles used in the refinery—which means that 4000 or more of them are handled during each working day; that's a total of approximately 1,000,000 per year.



SECOND CAT CRACKER at Pan-Am Southern's refinery at El Dorado, Ark., was dedicated April 14, a month ahead of schedule. The new 9300 b/d Fluid unit, designed and built by Foster Wheeler Corp., completes the first phase of Pan-Am's 5-year expansion program in the South. A 420 ton/day delayed coker was put into operation last August.

THIS'LL PROVE I'VE BEEN HERE — (L to R) E. A. Todd, Skelly Oil Co.; Boyde F. Koepke, Aluminum Company of America; L. M. Ferguson, Sinclair Refining Co.; George R. Lake, Union Oil Co. of Calif.; W. L. Baker, World Oil; E. R. Hoyle, Sinclair Refining Co.; J. H. Urian, Sun Oil Co.

Refiners Retreat to Tulsa to Talk Tough Topics

The Mayo Hotel in Tulsa became a haven for the country's refiners the first week of this month, when the Refining Division of the American Petroleum Institute held its 16th Midyear Meeting there. Although the meeting began officially on Monday, April 30, committee activities got under way the preceding Saturday and lasted through May 4. PETROLEUM PROCESSING had four staff men and a roving photographer on the scene. Some of the results of the latter's efforts are shown on these pages.

WHAT'S ON THE PROGRAM?—(L to R) W. C. McCrone, Armour Research Foundation; C. P. Stark, Phillips Petroleum Co.; K. L. Mills, Phillips Petroleum Co.; F. O. Jackson, Minneapolis, Minn.

GAB-FEST BETWEEN SESSIONS—(L to R) Tom Apjohn, Petroleum Administration for Defense; Charles M. Ridgeway, Pure Oil Co.; M. P. Murdock, Ethyl Corp.; D. P. Barnard, Standard Oil Co. (Ind.).

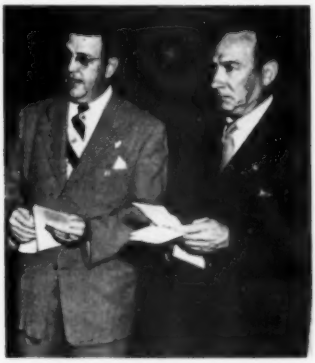
TIME OUT—(L to R) H. G. Hall, The Texas Co.; H. M. Wilten, The Texas Co.; O. F. Campbell, Sinclair Refining Co.; Bruno Siegel, Sinclair Research Laboratories.

ANOTHER TRUMAN JOKE?—L. C. Burroughs, Shell Oil Co. (left) and J. Porter Langfitt, Pure Oil Co.

A "WORKING" COMMITTEE—(L to R) Louis Mittelman, Tide Water Associated Oil Co.; Don Stevens, Standard Oil Co. (Ohio); Roy Weston, Atlantic Refining Co.; Donald Cleveland, Shell Oil Co.; W. H. Barcus, Sun Oil Co.

GOOD TO SEE YOU AGAIN—Roger Shute, Filtrol Corp. (left) and Harry Lutz, Socony-Vacuum Oil Co.

DINNER TABLE CONFERENCE—(L to R) S. S. Kurtz, Jr., Sun Oil Co.; R. Robert Brattain, Shell Development Co.; Dr. F. D. Rossini, Carnegie Institute of Technology.



WHO IS THAT FELLOW?—H. Ben Young (left) and Miller V. Sparks, Mission Manufacturing Co.

NOW LET ME SEE—Terence B. Berry, Imperial Oil Ltd. (left) and E. L. Gunn, Humble Oil & Refining Co.

THINKING IT OVER—(L to R) A. E. Harnsberger, Pure Oil Co.; R. J. Hafsten, Standard Oil Co. (Ind.); J. S. Cook, Humble Oil & Refining Co.

HERE'S HOW IT WORKS—Howard West, Standard Oil Co. of Ohio (left) and W. L. Bowler, Pure Oil Co.

DISTAFF SIDE — (L to R) Marceline Marquis, Ethyl Corp.; C. M. Gambrill, Ethyl Research Laboratories; Frances W. Lamb, Ethyl Research Laboratories.

A QUICK SNACK—(L to R) John F. Kinder, Sinclair Research Laboratories (left) and Dan M. Krausse, Cosden Petroleum Corp.

TEN MINUTE BREAK—(L to R) M. S. Northup, Standard Oil Development Co.; A. E. Harnsberger, Pure Oil Co.; R. J. Askevold, Pure Oil Co.; E. Q. Camp, Humble Oil & Refining Co.

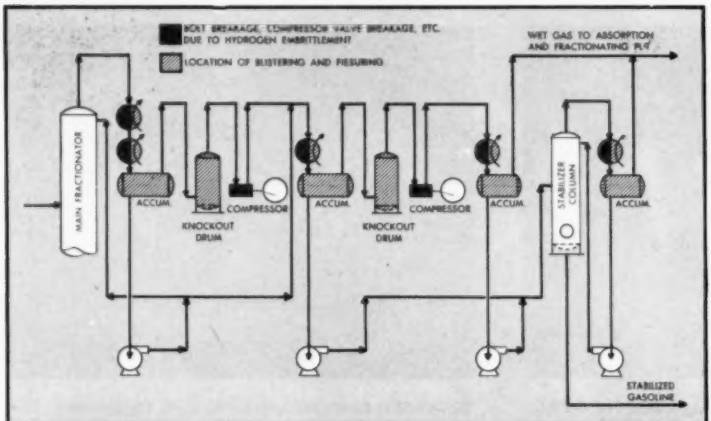


FIG. 1 — MOST LIKELY LOCATIONS for hydrogen attack in a typical cat cracker gas compression plant

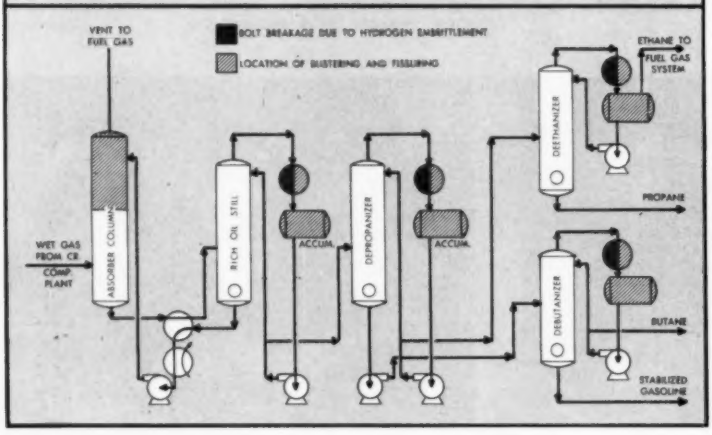


FIG. 2 — MOST LIKELY LOCATIONS for hydrogen attack in a typical gas absorption and fractionating plant

Hydrogen Attack on Steel

A corrosion prevention program for process equipment, particularly in catalytic cracking gas plants

By R. T. EFFINGER, M. L. RENQUIST, and J. G. WILSON, Shell Oil Co., and A. WACHTER, Shell Development Co.

The complete paper from which this material was taken was presented by the authors at the 16th Mid-Year Meeting of the API Division of Refining, Tulsa, May 1, under the title "Hydrogen Attack of Steel in Refinery Equipment." Omitted are sections on the general mechanism of hydrogen penetration and some laboratory investigations.

HYDROGEN attack of steel in refinery equipment is apparently becoming more prevalent, particularly since the general attention of the industry was first called to it a few years ago.

Shell Oil Co. has made a detailed study of the problem by investigating and visiting many refineries experiencing the phenomenon. Their report is limited to hydrogen attack which occurs with the types of low-carbon steel commonly utilized in the construction of refinery process equipment and piping. It is also limited to the attack associated with aqueous solutions, in which the hydrogen which penetrates the steel is a product of the electrolytic corrosion cell.

The survey indicated that corrosion by hydrogen blistering, fissuring, and embrittlement has been experienced

in the following operations:

1. Natural - gasoline plants which process sour gas and gasoline.
2. Storage tanks used for sour gases and gasoline.
3. Gas - recovery and fractionation plants associated with catalytic cracking units.
4. Hydrogen-sulfide removal and disposal plants.
5. Storage tanks used for strong sulfuric acid.
6. Hydrogen-fluoride alkylation plants.

By far the largest economic loss caused by hydrogen damage is experienced in environments where hydrogen sulfide is encountered (the first four conditions enumerated). Only a few cases of hydrogen damage in sulfuric-acid storage tanks and in HF alkylation plants have been reported. Although these latter instances of hydrogen damage are important and deserve study, the pressing problems were those encountered in sour hydrogen-sulfide environments; thus efforts were concentrated upon this phase, with particular emphasis upon controlling the attack in catalytic cracking gas plants.

Damage to Cat Cracker Gas Plants

A simplified flow diagram for a typical catalytic cracking gas compression plant is shown in Fig. 1, and a simplified flow diagram for an absorption and fractionating plant is shown in Fig. 2. These flow diagrams represent the simplified basic features of most plants, and indicate the locations where hydrogen attack is likely to occur. They are presented as a composite of the experience of various refiners. No single plant has experienced hydrogen attack in all of these locations.

As a result of the Shell survey, certain facts were established on which a corrosion prevention program could be based. They are:

1. Hydrogen attack is experienced only in environments where free-water phases are known to exist, regardless of the temperature and pressure. In no instance has low-temperature hydrogen penetration, blistering, fissuring, or embrittlement been discovered where an aqueous phase is not present.

2. In all locations where hydrogen attack occurs, hydrogen sulfide is a component of the process stream. However, no correlation exists between the concentration of H_2S and the severity of hydrogen attack. In some locations where high H_2S concentrations are encountered, there is no evidence of hydrogen damage.

3. The attack is observed in environments which have a wide range of pH. Severe damage has been observed under both acidic and mild-to-strongly-alkaline conditions. Several instances indicate that the attack occurs in strong sodium hydroxide solutions.

4. Cyanides are suspected to be promoters of the attack, from the following observations:

a. At many locations where the attack is severe, blue-grey deposits are formed in the equipment; and, when these are washed from the vessels and allowed to stand in the air, a deep blue (prussian blue) stain develops. Analysis of these deposits confirms that they are ferrocyanide. In other locations the distinct odor of cyanide is detected in the water layers drained from hydrogen-damaged equipment.

b. Blistering has occurred in the stripper columns of several diethanolamine plants for H_2S removal, and has not occurred in other similar plants. Only in those plants where blistering occurs were cyanides reported.

c. Blistering and related hydrogen damage appear to be more severe in plants with heavier feed stocks, such as those prepared by solvent-deasphalting of crude or by deep flashing, or where entrainment of heavy ends is excessive. It is established that nitrogen compounds are more prevalent in heavy crude fractions and that, in catalytic cracking operations, they crack to cyanides.

5. The concentration of water-soluble components appears to be critical. In numerous instances the streams are contacted with minor quantities of water in order to reduce the formation of plugging deposits. Following these light water-washing operations, hydrogen damage appears to increase. It is thus suspected that a critical balance of water-soluble components may exist under which the attack is negligible, and that this balance may be upset by removing only part of the water-soluble components.

Meet the Authors

Mr. Effinger

R. T. Effinger received his B.S. in chemistry from the University of Washington in 1938. He had joined Shell Oil Co. first in 1935 as a laboratory inspector at the Martinez refinery. He rejoined the company in 1939 as plant technologist. From 1942 to 1949 he was corrosion engineer at Martinez, and since that time has been senior engineer at the refinery. Mr. Effinger is a member of Shell's special committee on hydrogen attack on steel, since August, 1950, devoting his efforts to this problem exclusively.

Dr. Wachter

Dr. Renquist

Melvin A. Renquist, with an A.B. in chemistry in 1938 from San Jose State College, and M.A. and Ph.D. in physical chemistry from Stanford University, joined Shell in 1942 at the San Francisco research and development department. Later he served as technologist at the Wilmington refinery. In 1948, Dr. Renquist transferred to his present post in New York as senior technologist in the process design group of the manufacturing technological department. He represents this process group in the special hydrogen attack committee.

Mr. Wilson

A. Wachter has been with Shell Development Co. since 1932. In 1938 he became head of the corrosion department at Emeryville, Calif. concerned with corrosion prevention in all phases of petroleum and related chemical operations. Dr. Wachter received his B.S. in chemistry in 1927 from College of the City of New York, and his Ph.D. in physical chemistry in 1930 from the University of California.

Joseph G. Wilson has a B.S. in mechanical engineering from the University of Michigan. He joined Shell in Mexico in 1933 first working at the Minatitlan refinery and later at Tampico in engineering, maintenance, and construction. In 1938 he transferred to Shell Development as head of the mechanical engineering section. In 1949 he returned to Shell Oil Co. as assistant manager of the manufacturing-engineering department.

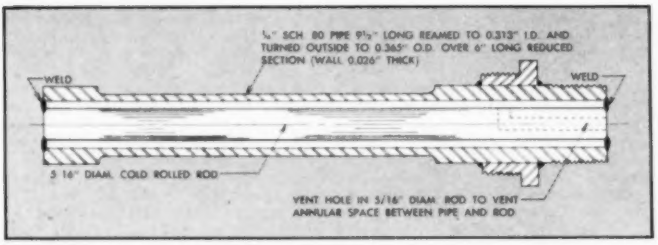

¼" SCH. 80 PIPE 9½" LONG REAMED TO 0.313" I.D. AND TURNED OUTSIDE TO 0.365" O.D. OVER 6" LONG REDUCED SECTION (WALL 0.026" THICK)
WELD
WELD
5/16" DIAM. COLD ROLLED ROD
VENT HOLE IN 5/16" DIAM. ROD TO VENT ANNULAR SPACE BETWEEN PIPE AND ROD

FIG. 3—HYDROGEN-ACTIVITY PROBE, construction details

6. An extensive water wash has the effect of removing the promoting agent or of reducing it to a safe level. Streams which had been contacted thoroughly with large quantities of water lose their ability to promote hydrogen attack.

7. It is known that active promoters are selectively extracted into the water phase. In one plant in which extensive water washing is practiced and in which no blistering is found in the gas plant itself, the water drainings from the unit are stripped of obnoxious gases in an atmospheric tower before the water is rejected to the sewer. The column, condenser, and overhead accumulator for this stripping operation blistered severely. This particular instance warranted special study, because the blistering occurred in the presence of large quantities of ammonia and under conditions of high pH. The attack was particularly virulent. Steel pads which were welded to the outside of the condensate accumulator, and which were fitted with a pressure gage, showed a hydrogen-pressure buildup in excess of 200 psi. in less than four days.

8. The active environment follows the light hydrocarbons throughout the process plants. The attack is severe in unstabilized gasoline streams but, after stabilization, occurs only in equipment which handles the butane, propane, and ethane fractions. No damage appears in subsequent equipment which processes or stores the stabilized gasoline.

9. In catalytic cracking plants the active components are produced in plants which use either natural or synthetic catalyst. Minor variations in the methods of catalyst regeneration have no marked influence upon the activity of hydrogen penetration in the catalytic cracking gas plants.

10. In general, the corrosion rates at locations where hydrogen damage occurred are of a moderate to low order of magnitude. Many are in the order of 0.001 in. to 0.010 in. per year. However, in isolated cases, as in the sour-water stripping column mentioned previously, severe hydrogen damage is associated with high corrosion rates.

11. The pattern of hydrogen damage in any one plant is erratic. In some locations blistering occurs only in certain condensers in banks of several parallel stacks. In others there is no evidence of blisters in condensers, but the accumulators are severely attacked. Furthermore, the pattern of attack in any one vessel is erratic. Examination of adjacent plates in the same vessel frequently shows one to be blistered severely with no evidence of blistering on the other. In general, the heads of pressure vessels are less severely attacked than the shells. More careful examination of some of this equipment has shown that, even though no blisters are found, the plates are badly fissured.

12. The pattern of attack inside a pressure vessel often appears to be associated with the phases in contact with the steel. In general, although there are exceptions, blistering is more severe in the vapor space of accumulators than in the aqueous layer which accumulates in the bottom of the vessel. In spherical vessels and in horizontal cylindrical accumulators, maximum damage often occurs in a band oriented 30 to 45° from the vertical, and in the bottom half of the vessel.

13. Tempered-alloy and high-carbon steels are more subject to embrittlement than are low-carbon mild steels. Tempered-alloy bolts, springs, and compressor valves are particularly susceptible to embrittlement when they are exposed to corrosive conditions which promote hydrogen penetration. In several instances where bolt failures have become intolerable, replacement of tempered-alloy bolts with mild steel bolts has been advantageous.

14. The austenitic grades of stainless steels are satisfactorily resistant to the corrosive environments which promote hydrogen penetration in carbon- and low-alloy steels. The ferritic grades of stainless steels are not suitable, as these steels become severely embrittled when they are exposed to environments conducive to hydrogen penetration.

15. Protective linings have been tried, but no really satisfactory enamel type of lining adaptable to field application has been found. Cement and concrete linings inside accumulators and tanks are used with success, but application is limited.

Inspection of equipment reveals that hydrogen attack is much more prevalent than has been suspected heretofore. The authors strongly recommend that inspection departments search carefully for signs of hydrogen damage. Although most cases of hydrogen attack which have been reported refer to blisters of steel plate, it is now known that, even where there is no evidence of blisters, many plates are fissured. It is most likely that meticulous inspection of vessels will reveal hydrogen attack not suspected previously.

Instruments and Testing Methods

Several means of investigating the environments which cause hydrogen attack may be followed. Among these are: 1) chemical analyses of the process streams from samples taken at a time when it is known that hydrogen is penetrating into the steel vessels; 2) use of the plant itself as an experimenal unit in which processing conditions can be varied and the effect of such variations in producing hydrogen penetration determined; and, 3) synthesizing of processing streams in the laboratory in which one component can be studied at a time and by determining the effect of such changes in the rate of hydrogen penetration of steel.

Early in Shell's program a need was recognized for an instrument that would measure the activity of environments which promote hydrogen penetration.

The instrument finally developed was a membrane type of hydrogen-accumulating device. It is illustrated in construction details in Fig. 3. Sensitivity is acquired by the use of a thin-walled small-volume probe which permits rapid hydrogen penetration and a measurable pressure change with only a small accumulation of hydrogen. The probe illustrated is fitted with a pressure-indicating gage. However, the same probe is adaptable to continuous record by the elimination of the screwed tee and gage, and by the brazing of a capillary-tube lead from a pressure recorder directly into the small-diameter vent hole in the central rod.

Prior to use these probes are tested for leaks either by pressure testing with hydrogen at 100 psi, or by evacuating to about 0.1 mm and observing any loss in pressure or vacuum after 24 hours. It is important that the probes be free of leaks because the rate of accumulation may be only a few milliliters of hydrogen per day. The volume inside the assembled probe is determined by applying two atmospheres of pressure and measuring the volume of gas re-

leased when the pressure is reduced to one atmosphere. Knowing the volume of the probe and the area and thickness of the thin wall, it is possible to express the activity of an environment in empirical units, and thus to compare probes which have slightly different dimensions.

Probes of this design have been extremely useful for the detection of environments which promote hydrogen penetration, and for the evaluation of the changes in operating conditions which influence the rate of hydrogen attack. In several cases probes had actually detected active hydrogen conditions before severe blistering or fissuring was evident.

In these investigations it was found that more sensitive probes could be constructed by making the area larger, by using cold-rolled in place of hot-rolled steel tubing, and by utilizing sensitive pressure-detecting devices. One such probe consisted of a thin-walled steel tube sealed to a Pirani vacuum gage. This probe was so sensitive that immersion for even a brief period in distilled water showed an indication of hydrogen penetration.

Determination of pH

The pH of aqueous phases in contact with the steel is an important factor in the evaluation of the environment, but accurate determinations of pH inside vessels which operate at a pressure of several hundred pounds per square inch are difficult. Ordinary glass electrodes are incapable of withstanding these pressures, and colorimetric methods are inaccurate when the water is discolored. The pH of water drainings has been approximated by withdrawing a sample, under pressure, into a clean gage glass in which indicator had been placed. Such measurements show that, in most cases, the water drainings from the bottom of accumulators are neutral to slightly alkaline.

Inasmuch as blistering has been observed to be more intense on the upper side walls of pressure vessels exposed to hydrocarbon liquid and vapor phases, it would be informative to have the true pH of the water droplets which condense upon the steel in these locations. Several attempts have been made to obtain this information, but without success. Analyses of the gas in some instances have shown negligible quantities of ammonia and appreciable acidic components such as hydrogen sulfide, carbon dioxide, and low molecular-weight organic acids.

Analysis of Process Streams

The sampling and analysis of process streams are fraught with difficulties which may not be readily apparent. In withdrawing samples of either hydrocarbon or aqueous phase from pressure equipment, elaborate systems are required to avoid the loss of volatile components. The determination of the true composition of the phases which exist inside a steel pressure vessel is further complicated by the fact that some of the compounds undergo transformation when the pressure is reduced, or between the time of sampling and analysis. Analyses for cyanide and cyanide complexes are particularly difficult because cyanides form esters, they hydrolize, or they react with other components so readily that true evaluation of the cyanide, cyanogen, or cyanide complexes which are in contact with the steel is virtually impossible. Improvement of the techniques of sampling and analysis of these streams is a problem which requires solution.

Avoiding Hydrogen Damage

From the accumulated data of plant experience and laboratory tests, it appears convenient to classify hydrogen-active environment as follows:

1. Environment in which relatively pure hydrogen-sulfide—water solutions are in contact with steel.
2. Environments in which hydrogen sulfide, water, and acids are present.
3. Environments in which hydrogen sulfide, water, cyanides, and ammonia are present.

In the first classification, continuing damage from hydrogen penetration is likely to be slight unless operating conditions are sufficiently fluctuating to damage the protective iron-sulfide scale formed. In these instances, addition of very small quantities of ammonia to the stream should be sufficient to increase the pH of the aqueous phase so that hydrogen penetration will not occur.

In the second classification, in which moderately strong acids such as formic, acetic, and similar acids are present, excessive quantities of ammonia may be required to raise the pH to safe levels. Furthermore, inasmuch as the solubility of ammonia in water is much greater than the solubility of the acidic components, it will be selectively extracted when water condenses from the stream. In an operating unit, re-injection of ammonia in several locations may be required. Obviously, the removal of water-soluble acidic components would be more practical. In a number of plants this is being accomplished by a thorough water wash of the hydrocarbon liquid and gas streams.

In the third classification, in which cyanide and ammonia are present, it is usually true that the stream also contains appreciable quantities of acidic components. In any event, mitigation will be effected if cyanide, ammonia, and acidic components are reduced to a safe level. This is being accomplished by an extensive water washing of the gas streams. The determination of the required degree of water wash can best be guided by the use of hydrogen-activity detection probes located at suitable points throughout the plant.

Plant Applications

Specific application of these corrective measures has been made at one refinery. This case will be described in detail. Hydrogen blistering was first observed in this plant in December, 1948, when severe blistering was discovered in the shells of 4 of 6 condensers located following the high-pressure stage of compression. In April, 1949, blisters were discovered in the rich-oil still reflux condenser. During 1950, 14 additional cases of blistering were discovered throughout the gas-compression and gas-fractionation plant associated with the catalytic cracking plants. These later cases include condenser shells, accumulators, and one absorber column. This alarming rate of increase in blistering damage demanded immediate investigation and mitigation.

An attempt was made to correlate the increased rate of blistering with operating variables, and it was found that blistering became apparent coincident with the startup of a new deep flasher. At about this same time severe difficulties were experienced with the formation of plugging deposits which consisted of iron sulfide and iron ferrocyanide.

Several years previously another catalytic cracking gas plant had experienced similar plugging difficulties, and the problem was alleviated by washing the gas streams with water. Based on these data, water washing was tried on the plant just described by utilizing temporary facilities to inject approximately 20 gpm. of water into the gas streams which have a capacity of 25,000,000 standard cubic feet per day. This reduced the plugging deposits, and operation of the water wash was continued in this manner for approximately six months.

In the meantime hydrogen-blistering damage was observed in several pieces of equipment. Therefore, two probes, sealed at each end and attached to a pressure gage through a piece of capillary steel tubing, were installed in vessels where blistering had occurred. The probes were of cold-drawn steel tubing 12 in. long, 1 in. in diameter, with a wall thickness of ¼ in. After approximately 30 days hydrogen pressure began to build up in these probes, and it was observed that the pressure buildup would stop when the water-washing operation was discontinued. In the light of this and the experience of other plants where meager water washing apparently promoted blistering, it was decided to discontinue water washing until further informa-

tion could be accumulated regarding adequate control of the blistering difficulties.

At this time the standardized probe previously described was developed and installed in critical locations throughout the gas and compression plants. These revealed that hydrogen activity was widespread throughout the plant, and that it was progressing even after water washing had been discontinued.

In an effort to alleviate the attack by raising the pH of the gas stream, a trial was made during which ammonia at the rate of 60 lb. per hour was injected into the gas ahead of the compressors. Measurements of the pH of the gas and water drainings indicated that much of this ammonia was being lost through extraction into the water phase drained from the accumulators following the compressors. Furthermore, vent gas lines became plugged with ammonium-carbonate deposits. Little or no ammonia was reaching equipment distant from the point of injection. In some equipment the rate of hydrogen penetration was reduced by this injection of ammonia; but, in other locations, the ammonia had negligible influence, or may even have increased the activity.

To investigate further the influence of ammonia, large quantities were injected into a column where the accumulator gas was strongly acidic and hydrogen penetration rates were high. In this instance, the test was conducted over eight hours; and it was observed that, when neutral conditions were maintained, pressure buildup in the probe stopped. After the ammonia injection had been stopped, only a few hours were required for pressure buildup to resume in the probe.

The water-wash facilities were revamped to permit the injection of a larger quantity of water at both the low-pressure condensers and the high-pressure condensers. More complete water washing has eliminated hydrogen activity in most locations, and has substantially reduced the activity in others. Further extension of water washing is planned so as to provide complete protection of the plant. It seems evident, from the experience in this plant, that protection of an entire gas-recovery system by water washing in only one or two locations is not feasible unless special facilities are provided to effect the complete removal of the offending components. This may involve the use of prohibitively large quantities of water. Apparently the concentration effect, which has been so evident throughout this investigation, becomes operative, so that process streams rendered inactive early in the flow scheme are reactivated as quantities and compositions change in subsequent fractionation steps. Thus a practical system of control would consist of a fairly heavy water wash of the gas streams early in the plant flow, with additional washing at other downstream locations which are shown to be active by pressure buildup on probes. That such a system is effective has been demonstrated in one plant which has operated for some years on a deep-flashed high nitrogren-content feed. In this plant no evidence of blistering has been encountered except in the water stripper, where obnoxious gases are removed from the wash water.

Previous Articles

For additional material on the subject of hydrogen corrosion the reader is referred to the following articles which have appeared in PETROLEUM PROCESSING during the past two years:

"Stopping Refinery Corrosion," May 1949, p. 540 (Vol. 4, No. 5)

"Hydrogen Blistering of Steel—A Source of Damage to Vessels," by M. H. Bartz and C. E. Rawlins, Aug. 1949, p. 898 (Vol. 4, No. 8)

"Corrosion Damage to Interior of Vessel Walls from Hydrogen Blistering Studied," March 1950, p. 253 (Vol. 5, No. 3)

API—CORROSION

Corrosion Cut in TCC Gas Plant

Water removal at key points by entrainment separation provides economical corrosion ontrol program

By C. A. MURRAY and M. A. FURTH, Pure Oil Co.

The complete paper from which this material was taken was presented by the authors at the 16th Mid-Year Meeting of the API Division of Refining, Tulsa, May 1, under the title "Corrosion-Prevention Program for a TCC Unit Gas Plant."

SUCCESSFUL corrosion prevention and control is being obtained in the gas plant for a pair of Thermofor catalytic cracking units at Pure Oil Co.'s refinery at Nederland, Texas, through use of water-removal measures at key points in the plant. An extensive inspection program had indicated that corrosion was almost entirely associated with excessive water present in the system.

Water-removal methods consisted chiefly of the use of coalescing-type water entrainment separators at two different locations and installation of a draw-off nipple at one other point. In addition some chemical injection was adopted as a further neutralization measure. The installations were justified economically on the basis of reduced corrosion in tubular heat exchange equipment in the gas plant.

For example: experience prior to the use of the entrainment separators had established a cost of approximately $1.20/sq. ft./yr. for direct material and labor charges for maintenance of heat transfer surface in the gas plant. The total installation cost of the separators and chemical injection equipment amounted to $0.45/sq. ft. of gas-plant exchanger surface. Results to date have left no doubt that the installation is economical, based on direct maintenance savings alone. Still larger and less tangible benefits have also resulted from improved continuity of operations of some of the fractionators and reduced caustic consumption in the gasoline scrubber.

The gas plant at Nederland serves two TCC units. It is conventional,

with a depropanizer, an absorber, debutanizer, and dependentanizer as the fractionation towers. Compression is in three stages, 40, 140, and 400 psi. There are various water separators, heat exchangers, coolers, and reboilers, all of which have been subject to varying degrees of corrosion.

Feed to the plant consists of liquid gasoline and lighter vapors from the TCC units. It includes water from process steam and corrosive chemicals such as hydrogen sulfide, ammonia, and volatile organic acids resulting from the breakdown of parent compounds in the charge oil during cracking.

Corrosion in the shell-and-tube type heat-exchange equipment has been unusually severe. Even though major retubing was done during regular inspection shutdowns of the unit, there have been frequent unexpected failures which occurred during operating periods.

The depropanizer charge-bottoms exchanger tube bundle had to be retubed or replaced five times in 65 months. The shell was replaced once, and thin spots on the new shell were wash-welded during the same period of time. Admiralty tubes were substituted for steel at the time of the second retubing, with a slight improvement in life. The debutanizer reboiler, which had steel tubes, was retubed or replaced six times in 61 months. These failures, having taken place in relatively hot streams, suggested the presence of a corrosion reaction accelerated by heat.

Admiralty tubes were used in the depropanizer and debutanizer condensers. The depropanizer condenser required four retubings because of corrosion from the process side over five years' operation. The debutanizer condenser required retubing once after four years of service, also because of corrosion from the process side.

The original steel tubes of the absorber charge cooler were replaced with steel after 16½ months of service, and then with 70-30 copper-nickel after 18½ months of service. Corrosion on the process side of both metals was noticeable, but not to the same degree as that experienced at other places in the gas plant.

Corrosion Causes

In searching for a possible explanation for corrosion in the depropanizer overhead stream and the absorber charge stream, it was found that quantities of water were associated with those streams. It was postulated that corrosive chemicals carried in water might be responsible in some degree for the corrosion encountered. This theory was supported by a comparison of the depropanizer and debutanizer condensers.

The depropanizer bundle was badly scaled and fouled: the debutanizer bundle retained a relatively clean appearance and showed no significant corrosion. It is felt that the differences in these condensers may be attributed, in part at least, to the relative quantities of water present in the streams. The intermediate amount of corrosion and scale found in the absorber charge cooler is felt to be the result of an intermediate quantity of water passing through this cooler.

Bundles in relatively hot streams experienced corrosion. Bundles in relatively cool streams with large amounts of water likewise experienced corrosion. But, in relatively cool streams where water was absent, the corrosion was negligible.

It was determined from qualitative analysis that the principal corrosives present were H_2S, ammonia, and unidentified organic acids, in water solution. Accordingly, a complete gas plant corrosion survey was made, the results of which are indicated in Table 1.

TABLE 1—Results of Complete Gas Plant Corrosion Survey

	gal./day	pH	ammonia %	H₂S %	organic * acid, %
1. Water entering from TCC cracked-oil tower overhead separator:					
A. Water vapor with gas feed to compression system (as liquid)	3850	....	....	....	....
Condensate from 1st-stage sep.	....	8.5	0.07	0.12	....
B. Entrained water with liquid hydrocarbon from north cracked tower overhead separator	850	8.5	0.035	0.054	....
C. Entrained water with hydrocarbon from south tower separator	300	8.0	0.042	0.081	....
Total water entering gas plant	5000				
2. Distribution of water through dependantizer:					
A. Water charged to dependantizer	300	8.0	0.042	0.081	....
B. Water leaving dependantizer overhead (plus reboiler leak during survey)	719	7.6	0.083	0.18	....
C. Water leaving dependantizer bottom	104	6.3	....	....	0.006
3. Distribution of water through depropanizer:					
A. Water charged	2090	8.5	0.30	0.53	....
B. Water leaving overhead	290	7.7	0.85	1.52	....
C. Water leaving bottom	1800	8.0	0.002	0.004	....
4. Distribution of water through debutanizer:					
A. Water charged	1800	8.0	0.002	0.004	....
B. Water leaving overhead	90	8.8	0.006	0.004	....
C. Water leaving bottom	1710	5.5	....	....	0.012
5. Est. water leaving absorber	320	7.3	0.143	0.336	....

* As acetic acid

Chemical Corrosives

From the foregoing it can be seen that there were normally 5,000 gal of water per day introduced to the gas plant. One source of water was vapor introduced with the gas from the cracked-oil tower overhead gas and water separators. A second source was entrained water carried along with gasoline from the bottom of each of the separators into the gas plant.

It will also be noted that, at the time of the survey, there was a dependantizer reboiler leak which introduced water into the dependantizer, from whence it progressed overhead, and on into the depropanizer charge. Water which had accumulated in the depropanizer charge accumulator was an alkaline solution containing ammonia and hydrogen sulfide. In bottom streams, however, such as the dependantizer or debutanizer reboiler, the water was slightly acidic. The water contained ammonium salts of organic acids which had dissociated at reboiler temperatures to produce an acid solution which, in conjunction with corrosion products carried to the reboiler, produced very severe localized attack on reboiler tubes.

It is very likely that the heated depropanizer charge stream and also the depropanizer reboiler stream sim-

Meet the Authors

Mr. Murray

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ilarly contained salts which gave acid conditions during actual operation.

In addition to corrosive chemicals carried by water in the streams, it was indicated that corrosion products, such as metallic sulfide sludges, were a factor in producing localized attack. The adverse corrosion influence of corrosion-product sludges was emphasized at the time of a debutanizer reboiler failure in January 1949.

Inspection indicated considerable iron-sulfide sludge lodged at the bottom of the reboiler bundle and also packed around the bottom reboiler tubes. Surface losses of bottom tubes which had been in the sludge averaged 0.020 in. Surface losses of top tubes which were not in contact with the sludge averaged 0.002 in. The bottom tubes were severely pitted, whereas top tubes had a slight uniform attack. Tubes of this bundle had been in service but three months.

Water Removal Methods

Three measures for water removal were subsequently put into effect. The first was the installation of a flood nipple in the bottom of the absorber tower, with the establishment of regular manual water withdrawal every four hours. It is believed this procedure has accomplished its purpose by lessening the load on an entrainment separator placed farther downstream.

The second measure was the installation of a coalescing-type entrainment separator on the depentanizer feed gasoline stream. This separator is simply a small vessel containing excelsior as a coalescing agent and with a small leg for trapping the separated water. The trap has an automatic liquid-level control for dumping separated water.

This unit has been very successful in operation, requiring no particular servicing or attention. Water removal at this point was to provide corrosion protection for the depentanizer charge-bottoms exchanger, the reflux condenser, and the reboiler. This section of the gas plant has not yet been open for inspection, and it is impossible to report results at this time.

The third water removal measure was installing another entrainment separator on the depropanizer charge stream, following its juncture with the absorber bottoms stream. At this point the stream is all in a liquid state, and the water present is susceptible to removal by coalescing means. Like the depentanizer charge entrainment separator, this unit also utilizes excelsior.

Although the water-removing capacity of this separator is larger than that for the depentanizer charge, its efficient operation depends to a large extent on adequate manual removal of excessive water from the depropanizer charge accumulator. Excess water still continues intermittently to load the charge accumulator, and will do so until such time as the separator efficiency on the north cracked-oil tower overhead stream is increased. The construction and location of the charge accumulator is such that its use as a water separator is difficult and inefficient, and it follows that the manual water-drawing operation is an inefficient one.

This difficulty is especially significant because large amounts of water were allowed to pass into the depropanizer charge stream during an initial two-month period before water-drawing procedures at the depropanizer charge accumulator were emphasized. It is likely that intermittent introduction of water into the depropanizer charge has occurred even during the following period of operation.

The depropanizer-debutanizer section of the gas plant was open to inspection January 1951—7 months after water-removal measures. It is possible in this short period of time to describe results which are considered indications of successful corrosion prevention.

Definite improvement in corrosion experience was found in the depropanizer charge-bottoms exchanger. Each previous year this tube bundle had been so extensively corroded on the shell side that retubing was necessary. During the last inspection shutdown the corrosion was minor for the bundle as a whole, and was severe at only two places. A small amount of sludge had lodged between the tubes and baffle at the first baffle, and between the tubes and tube sheet at the floating tube sheet. The sludge and corrosion had been confined to these two places only on the bottom three rows of tubes. At the point of sludge contact with the tube, the tubes had corroded areas 1 in. to 2 in. long. It is emphasized that, except for these two areas of sludge accumulation, at no place had the tubes lost significant amounts of metal. Previously all tubes of this bundle had shown excessive corrosion for a similar period of operation. It is believed that the corrosion in this exchanger reflects the periodically inefficient water removal at the depropanizer charge accumulator, as well as consequent interference with operation of the entrainment separator which has already been described. There is little doubt that, with water substantially eliminated from the charge stream, future corrosion will be negligible in this exchanger.

Evidence was also found that water removal was not complete, and that corrosion had not been altogether stopped in the depropanizer reboiler. This reboiler contained excessive deposits of sludge and evidence of slight corrosion on the bottom tubes. However, the corrosion was not so severe as had formerly been experienced, and it was not necessary to retube the bundle. As in the case of the depropanizer charge-bottoms exchanger, it is felt that the remaining corrosion in this case is largely the result of occasional inadequate water removal at the depropanizer charge accumulator and at the entrainment separator. As measures are taken to increase separator efficiency in streams which feed the depropanizer accumulator, the intermittently high load on the depropanizer entrainment separator will be eliminated. Depropanizer reboiler corrosion then should be reduced to minor proportions.

Excellent corrosion reduction had occurred in the debutanizer reboiler, although large quantities of sludge deposits again were found in this vessel. The reboiler tubes were not corroded at all, even at the bottom of the bundle, where they had been surrounded by sludge, because of the absence of water from the reboiler. The water-removal program is indicated as successful in eliminating severe corrosion at this reboiler, where formerly attack was intolerable.

After no accumulation for two years, the re-appearance of substantial amounts of sludge deposits in the reboiler was surprising. This reoccurrence may be explained by the fact that there is now a lack of water in sufficient quantity in the reboiler to flush deposits from the bundle to the outlet nozzle.

There were two immediate operational benefits which resulted when the driers had been put in operation. These are mentioned as indicative of unexpected advantages—actually having no connection at all with corrosion—which may result from a corrosion-control program.

Operational Benefits

One benefit is the reduction of caustic consumption at the gas plant. It was necessary to charge the debutanized gasoline caustic scrubber with fresh caustic at least every other day, largely because of dilution of caustic with excess water which passed through the gas plant. Initiation of the water-removal operation immediately stabilized the consumption of caustic in this scrubber, and it was not necessary thereafter to recharge with fresh caustic more than once a month.

A second benefit was distinctly improved operation of both the depropanizer and the debutanizer towers. This had been somewhat erratic because of water accumulation and because of slugging into the reboiler. Water drainage through the reboilers caused by notching of baffle plates, as well as the removal, later on, of entrained water from the feed stream eliminated this difficulty.

Progress Reports on Activities of API Refining Division Committees

To acquaint the industry more widely with the work and activities of the technical committees of the API Refining Division, Petroleum Processing has again arranged for these annual progress reports. They have been prepared for us by the various committee chairmen, with the cooperation of W. T. Gunn, director of the Division, and his staff.

Analytical Research

Chairman—E. L. Baldeschwieler
Standard Oil Development Co.

THE Committee on Analytical Research promotes knowledge of analytical laboratory tools and fosters the application of new techniques to analytical problems in petroleum laboratories. Such tools and techniques are being found useful for purposes of control and as research tools for evaluating intermediate products, for obtaining material balances and for better understanding of reaction mechanisms.

The Committee has seven Subcommittees which have been very active last year.

The Subcommittee on Analysis of Oxygenated Compounds has tested three modifications of the Unterzaucher method for the direct determination of oxygen in organic compounds. All three procedures gave satisfactory results for the determination of small amounts of oxygen.

Results of cooperative work on the use of the electrode dipping technique will be published shortly by the Subcommittee on Emission Spectroscopy.

The Subcommittee on Determination of Nitrogen has tested four different techniques and will be in position to recommend at least one method of universal application.

The Subcommittee on Trace Elements Analysis has investigated methods for the determination of very small amounts of ash in various materials and has for its ultimate goal the complete analysis of these ashy constituents as a help in the study of cracking catalyst contamination.

The subcommittee on Waste Disposal Analytical Methods has tested cooperatively five procedures for the determination of oil content in effluent waters and recommended a combination of two methods to be tested cooperatively by the Committee on Refinery Waste.

The Subcommittee on X-Ray Diffraction Data is engaged in the collection of x-ray diffraction patterns amongst its members for submission and distribution by ASTM.

A new Subcommittee on Sulfur and Sulfur Types has been organized and will hold its first meeting in the near future.

Automotive Research

Chairman—J. T. McCoy
Tide Water Associated Oil Co.

PURPOSE of the Automotive Research Committee is to study characteristics of automotive equipment which affect the utilization of petroleum products, and to sponsor investigations that are required to promote the most efficient use of automotive fuels and lubricants. This committee also acts as a forum for the discussion of industry problems on automotive fuels and lubricants, and sponsors group sessions on automotive fuels and lubricants.

Three members of the Automotive Research Committee represent the Lubrication Committee of the Division of Marketing, in order to have close liaison between the Automotive Research Committee and the Lubrication Committee.

To assure prompt action on problems arising between formal meetings of the committee, it is organized into four regional sub-committees.

In cooperation with the United States Bureau of Mines, fuel surveys are issued annually. The API arranges for the industry to contribute data, which are tabulated and analyzed by the Bureau. Reports on characteristics of motor gasolines, diesel fuels and aviation fuels thus are made available to the public. The 1951 aviation fuel survey will be expanded to include jet fuels.

Research projects of interest to the Automotive Research Committee at present are conducted by the Coordinating Research Council, a non-profit organization sponsored jointly by the petroleum and automotive industries. The Automotive Research Committee is responsible for formulating recommendations for API support of projects undertaken by CRC and also recommends nominees for the petroleum-industry members of the CRC Board of Directors. The Chairman of the committee serves as a member of the CRC Assignment Committee, which reviews all research projects before they are undertaken.

Currently more than half of the work of the Coordinating Research Council is carried on military projects, either initiated at the express request of the armed services, or supported in part by them. Typical projects include research on fundamentals of detonation, survey of octane requirements of cars and trucks, development of road test techniques for evaluation of fuels, field service tests of railroad diesel fuels, low temperature pumpability of jet fuels, combustion characteristics of jet fuels, study of engine deposits, and study of aircraft lubrication.

Most of the CRC research projects are carried out on a cooperative basis in the laboratories of the automotive and petroleum industries. In addition some of the projects are being investigated at the U. S. Bureau of Mines, Battelle Memorial Institute, and in university laboratories.

Results obtained from these investigations usually are published, unless they relate to classified military information.

Disposal of Refinery Wastes

Chairman—R. N. Giles
Standard Oil Co. (Ind.)

THE Committee on Disposal of Refinery Wastes collects and makes available in convenient form technical information that will assist refiners in preventing the escape of noxious wastes. When the desired information is not available in the literature, or from the experience of the industry, appropriate research projects are planned, sponsored, and guided by the committee. Such projects are industry-financed.

Two research projects will be brought to a close during 1951:

(1) Studies of the hydraulic behavior of gravity-type oil-water separators. This subject is being carried out at the Hydraulic Laboratory of the University of Wisconsin, under the direction of the Subcommittee on Oil-Water Separation. The results will be utilized in preparing a revision of Section I of the "Manual on the Disposal of Refinery Wastes."

(2) Development of laboratory

techniques for determining toxicity of various substances to plankton forms occurring in fresh and brackish waters. This project is being conducted at the Academy of Natural Sciences in Philadelphia, under the direction of the Biological Subcommittee.

The Committee has compiled, and has revised from time to time, a "Manual on the Disposal of Refinery Wastes." For many years the manual has been published by API in three sections: I—Waste Water Containing Oil; II—Waste Gases and Dusts; and III—Waste Water Containing Solutes. It is planned to alter this arrangement over the next year or two so that the manual will be published in five volumes: I—Waste Water Containing Oil; II—Waste Gases and Particulate Matter; III—Chemical Wastes; IV—Analyses for Liquid Wastes; and V—Analysis for Waste Gases and Particulate Matter. The principal advantage of this new arrangement is that all analytical methods will be segregated from the engineering portions of the manuals.

Manuscript for Volume II—Waste Gases and Particulate Matter has been written during the past year. When published, in the near future, it will replace Section II (Third Edition). The manuscript for Volume III—Chemical Wastes, is ready for publication as a replacement for Section III—Waste Water Containing Solutes (Fourth Edition). Both of these volumes represent extensive revision and expansion of the subject matter, and will present up-to-date information on sources, properties, and means of controlling and treating the kinds of waste considered.

Petroleum Products

Chairman—A. E. Miller
Sinclair Refining Co.

THE Committee on Petroleum Products has responsibility for the formulation of all recommendations on matters pertaining to specifications, methods of test and methods of measurement for petroleum products, and considers all suggestions for recommendations in this field whether initiated in the committee or in other groups in the American Petroleum Institute.

It also, when properly authorized, directs API sponsored investigations and development on matters appropriate to the field of petroleum products.

During 1950 the main activities of the committee were carried out by its various working subcommittees.

The Glossary Subcommittee has completed and distributed to committee members for comment the first draft of the glossary of petroleum refining terms, which gives definitions not available in desk type dictionaries. As soon as comments have been received and considered the glossary will be offered to the committee for authority to publish.

The Subcommittee on Viscosity at High Rates of Shear has completed its work on the relationship of the viscosities of oils of various compositions when determined by conventional viscosimeters as compared to determinations made at high rates of shear. The finished reports have been submitted to the ASTM for publication as a technical pamphlet. These reports included all of the detailed data obtained during the work.

The Viscosity Project Subcommittee working with the Franklin Institute has been studying the possibilities of measurement of oil viscosity by the use of a torsionally vibrating crystal. A final report on this subject entitled, "Factors Affecting the Preparation of Viscosity Measurements with the Torsional Crystal", has been submitted by the Franklin Institute and accepted by the Committee.

The Subcommittee on Vapor Temperature Data is acting in an advisory capacity to the API sponsored fellowship at Northwestern Technological Institute. The purpose of this fellowship is the preparation of much needed vapor pressure-temperature correlations of petroleum fractions. This project is strictly a paper study and uses data from the Research Division of ASTM D-2, which in turn comes from various oil company laboratories. Calculations and graphing of the data are now being carried out by graduate students at the University.

The Subcommittee on Octane Precision has been functioning in an advisory capacity to the project which is working on the problem of attempting to eliminate the effect of atmospheric pressure on the determination of octane numbers in gasoline. During 1950 it was decided that the main items of the program would have to be the development of a pressurized test unit in which the carburetor and other parts of test equipment would be under a positive controlled pressure. In view of the course taken by the project the API transferred sufficient funds allocated to this project to the research division on combustion characteristics of fuels of the ASTM with the understanding that the Committee on Petroleum Products would be advised of the work of the ASTM Committee from time to time. As of this writing the work is proceeding very satisfactorily in that the engineering work on the carburetor had been completed and the carburetor is being constructed.

The Subcommittee on Oil Measurement Calculations is functioning in an advisory capacity to a joint project of the British Institute of Petroleum and the ASTM for the preparation of tables for calculating oil volumes from the temperature of measurement to a standard temperature, converting units of volume to units of weight and vice versa, and for making conversions from one system of measurement to another. During 1950 all of the calculations were completed and the data are presently being set up in type preparatory to printing. These tables will be available for purchase in the near future.

In 1949 a Study Committee recommended that the API decline to support the secretariat of the International Standards Organization project 28 on Petroleum Products. In view of new developments in the International situation another study group was appointed to reconsider this situation. During 1950 the Committee on Petroleum Products agreed that the API should sponsor ISO T/C 28 for the first year and that the Director of the Division of Refining be appointed as secretary.

A subcommittee was appointed to investigate the possibility of a cooperative abstracting service for the petroleum industry. This subcommittee reported a reasonable amount of interest on the part of the various units of the industry in such abstracting services and with the approval of the General Committee of the Division of Refining intends to give the project further study, possibly to the point of recommendation.

Another study committee has been actively looking into the propriety of the API sponsoring the Bureau of Mines proposal to develop an improved method of crude oil assay.

The Subcommittee on API Viscosity Standards has rechecked the standard Alpha, Beta and Gamma oils for viscosity and official values have been adopted for this year. In view of some difficulty in obtaining duplication during this year's standardization, the general subject of improving the calibration of viscosimeters has been reopened by the subcommittee and referred to ASTM for study.

(Report prepared by H. W. Field, Atlantic Refining Co., 1950 chairman.)

Refinery Equipment

Chairman—W. H. Creel
Phillips Petroleum Co.

THE Committee on Refinery Equipment has the responsibility of fostering the API program of standardization of refinery equipment and of formulating recommendations on engineering practice in the promotion of safety for the plant, worker, and general public.

As a matter of policy, the committee does not organize standardization projects in a given field except (1) when no other authoritative agency is willing or able to undertake the particular problem or (2) when such authoritative agency is unable to provide needed standards acceptable to the petroleum industry. When developing standards suitable for the petroleum industry, the com-

mittee cooperates with established agencies by naming representatives to serve on committees and working groups.

When there is no agency working in a given field, the committee organizes needed projects. When standardization is involved, the consultation and co-operation of the manufacturers of the equipment in question are enlisted.

At present, the committee has ten active projects, each one of which is carried out by appropriate subcommittees. These projects are:

Study of the Design and Construction of Unfired Pressure Vessels—This project is handled by the Subcommittee on Unfired Pressure Vessels, N. J. Rees, Chairman. The subcommittee acts as an advisory forum to the API members of the Joint API-ASME Committee on Unfired Pressure Vessels. It has assisted in the preparation of a revision of the API-ASME Code for Unfired Pressure Vesesels for Petroleum Liquids and Gases which will be issued shortly as the 1951 Edition. This revision is an endeavor to bring the rules up to date with the progress in the art of pressure-vessel construction since the issuance of the 1943 Edition of that code.

Study of Low-Pressure Storage Tanks—This project is being considered jointly by the Subcommittee on Field-assembled All-Welded Pressure Vessels, W. L. Bowler, Chairman, and the Manufacturers' Subcommittee on Field-Assembled Pressure Vessels, H. C. Boardman, Chairman. These subcommittees are engaged in the preparation of a proposed code for the design, construction, inspection, and repair of low-presure (less than 15 psi.), field-assembled, welded vessels which are not covered by existing codes or standards.

Study of Inspection Procedures for Petroleum Refineries—This project is being conducted by the Subcommittee of Refinery Inspection Supervisors, H. F. West, Chairman, which is engaged in preparing a manual of Recommended Practices for Refinery Inspections.

Efforts to date have resulted in the publication of four parts of the projected manual: Part I, Process Equipment; Part II, Pressure-relieving Systems; Part III, Fire Protection Equipment; and Part IV, Low-Pressure Storage Tanks. Part V, Instruments, and Part VI, Electrical Equipment, are under preparation.

Study of the Design and Construction of Pressure-relieving Systems—This study is being conducted by the Subcommittee on Pressure-relieving Systems, J. C. Souder, Chairman, with the assistance of a Manufacturers' Subcommittee on Safety and Relief Valves, L. P. Stillman, chairman.

This subcommittee now has under consideration a Bulletin on Pressure-Relieving Systems which will cover: (1) necessity for pressure-relieving systems; (2) determination of relieving capacity to meet operating conditions; (3) determination of relieving capacity and protective jackets on vessels to protect against exterior fire; (4) discharge piping and disposal facilities; (5) use of depressuring means; (6) types of relief devices; and (7) installation of relief devices.

Study of Corroson of Refinery Equipment—This project is under the Subcommittee on Corrosion, E. Q. Camp, Chairman. The subcommittee acts as a forum for the discussion of corrosion problems and sponsors technical symposia on the subject.

Study of Tank Accessories and Cleanouts—This project is under the Subcommittee on Tank Accessories and Cleanouts, E. E. Kerns, Chairman. The studies of the subcommittee have convinced the members of the desirability of standardizing the design of tank cleanout openings, as a result of which a Manufacturers' Subcommittee on Tank Cleanouts has been organized and is assisting in the preparation of such a standard.

Study of Mechanical Equipment—This project is under the Subcommittee on Mechanical Equipment, E. F. Voss, Chairman. The subcommittee is surveying the field of pumps, compressors, and like equipment and is assessing the opinion of the petroleum industry on the desirability of developing standards in the field. It has prepared a proposed specification for centrifugal pumps which will be referred to a manufacturers' subcommittee, when organized.

Standardization of Refinery Valves—This project is under the Subcommittee on Valves, R. H. Bungay, Chairman, and the Manufacturers' Subcommittee on Refinery Valves, W. P. Kliment, Chairman. The project resulted in the publication of API Standard 600A on Flanged Steel Outside-Screw-and-Yoke Wedge Gate Valves in 1938 and API Standard 600B on Flanged Steel Plug Valves in 1940. In 1949 these two standards were judged obsolete and were replaced by API Standard 600 on Flanged and Welding-End Steel Wedge-Gate and Plug Valves for Refinery Use.

Study of Refinery Instrumentation—This project is handled by the Subcommittee on Instruments, G. N. Ehly, Chairman. This subcommittee is engaged in drafting a recommended practice for the inspection of control instruments. When completed, it will be referred to the Subcommittee of Refinery Inspection Supervisors for approval as Part V, Instruments, of the Recommended Practices for Refinery Inspections.

Study of Electrical Equipment—The Subcommittee on Electrical Equipment, L. M. Goldsmith, Chairman, is in charge of this project. It is engaged in drafting recommended practices for the inspection of electrical equipment which, when completed, will be referred to the Subcommittee of Refinery Inspection Supervisors for approval as Part VI of the Recommended Practices for Refinery Inspections.

Training

Chairman—T. M. Rushing
The Texas Co.

THE Committee on Training in Refining has the responsibility of assembling and making available to the Refining Industry significant information concerning employe training. The Committee discharges its responsibility by sponsoring forums for the discussion of training subjects, publishing the results of surveys and studies, and through cooperation with allied industry groups.

During the past year, the Committee has sponsored a group session for the Division of Refining dealing with the subject of Supervisory Training, a seminar dealing with the general theme of Economic Education of Employes, and has taken the initial steps toward the formation of a Manufacturers' Sub-committee which hopes to improve the caliber of instructional literature provided by manufacturers of equipment.

At the present time, the Committee has three active sub-committees engaged on projects.

(1) Sub-committee on Pump Maintenance Guides — J. J. Stadtherr, Pure Oil Company, Chairman. This sub-committee proposes to organize a Manufacturers' Sub-committee for the purpose of making the literature furnished by pump manufacturers more applicable to the training of maintenance mechanics and operating personnel, without detracting in any way from its value to engineers and other technically trained people. This particular project has been under consideration by the Committee on Training for more than two years.

(2) Sub-committee on Training Literature—Dean S. Turner, Standard Oil (Ohio), Chairman. The Committee on Training has long recognized that one of the primary needs of the industry is an adequate library service in the special field of training. The Sub-committee on Training Literature is expected to make a definite recommendation at the 16th mid-year meeting in Tulsa, looking toward the establishment of such a service.

(3) The Gulf Cost District Subcommittee—C. H. McKennon, Neches Butane Products Company, Chairman. This sub-committee serves as a forum wherein training supervisors located in the Gulf Coast area are able to meet periodically for the discussion of matters of common interest. The Committee also periodically carries out special projects at the request of the parent committee.

FIG. 1—HEAVILY LOADED SEMI-TRAILER UNIT, one of the six identical road test vehicles used in . . .

Road Testing Petroleum Products

Good reproducibility of results is obtained in convoy operations of commercial vehicles at high overloads

By I. T. ROSENLUND, Automotive Technologist, Petroleum Chemicals Div., du Pont Co., Wilmington, Del.

THE evaluation of the performance of new petroleum products prior to release for consumer usage is a complex problem. In testing a promising new product, the petroleum industry spends an enormous amount of effort devising test methods for indicating expected service performance. The test procedures range from laboratory bench tests and single-cylinder engine tests to full scale engine tests. Despite extensive laboratory testing, recourse is still made to service testing a new product on the road for a final evaluation of its performance.

Service testing in its true sense requires the utilization of an adequately large fleet of passenger cars or trucks, operated under customer service conditions. One common practice is to divide the fleet into two groups, one group operating as the control and the other on the single variable under investigation. In such tests, it is highly improbable that any two vehicles are operated exactly alike over the same terrain, and the resulting data must be treated on a statistical basis. This, of course, means that a large number of vehicles must be included in the test program.

Another method of obtaining service performance data is to operate a smaller number of vehicles under exactly the same conditions, in a convoy, over a prescribed route, in a carefully controlled manner under simulated service conditions. One of the major problems with this type of testing is the establishment of an operating regime which reproduces the actual conditions encountered in the type of service to be duplicated. Climatic variations preclude the possibility of one road test in a single area which will adequately proof test a new product under all conditions of service. However, the basic procedures for the various road tests can be quite similar.

Several years ago, when the du Pont company started a research program directed towards providing improved anti-knock compounds, the type of road testing to be employed for evaluating experimental products was carefully studied. It was decided that experimental products which had survived the rigors of laboratory endurance testing would be first road tested in convoys of trucks and passenger cars, operated by laboratory personnel. It was further decided that the next and final stage in the evaluation program would be actual tests in fleets operated by commercial consumers, where the variety of climatic conditions could be included as a test variable.

The du Pont heavy duty road tests in commercial vehicles at high ambient temperatures are carried out at El Monte, Calif. These tests simulate the severe end of road test evaluation—that represented by commercial vehicle operation under highly overloaded conditions. It is the purpose here to discuss the test work conducted at El Monte and to describe some of the procedures and special precautions observed to obtain a reasonable degree of reproducibility.

Road Test Vehicles

The current procedure was designed to test experimental anti-knock fluids under the severe conditions typical for an overloaded engine engaged in inter-city trucking. Commercial ex-

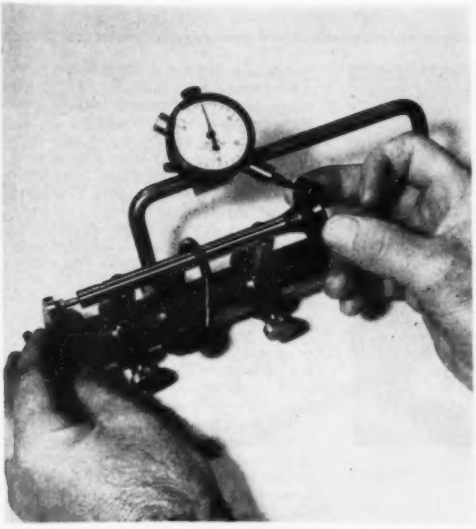


FIG. 2—VALVE FACE CONCENTRICITY is checked with this Demay valve gauge

FIG. 3—VALVE SEAT CONCENTRICITY is checked with this jig

amples of this type of operation are encountered when light trucks are used for semi-trailer units as automobile transports, moving vans, grain and hay haulers, and other types of industrial hauling.

The selection of the vehicles was made on the basis of a careful study of service performance records. It was desired to use a popular engine which might readily show differences between experimental products, on the theory that these differences would also exist to a greater or lesser degree in other types of engines. The unit finally selected was a semi-trailer combination powered with a 235 cu. in. valve-in-head engine.

Fig. 1 shows one of the six identical semi-trailer units used in the tests. The partitions in the body of the trailer were installed to prevent shifting of the gravel used to load the vehicles. This precaution was necessary to maintain a constant load on the tires which are experimental tires undergoing service testing for the Rubber Chemicals Division of the du Pont company.

The gross weight of each vehicle is 26,000 pounds, corresponding to a 60% overload for the tractor rating. With this loading, full throttle operation is required over most of the test route. The trucks are operated in convoy 16 hours per day, testing two experimental anti-knock compounds, one in each of three units. Drivers and positions of the trucks are rotated daily to overcome variations which might be caused by differences in driver techniques. Great care is exercised by the drivers in treating all trucks exactly alike, even to minor details such as braking, accelerating and shifting of gears. It has been found that scrupulous attention

FUEL FLOW TO CARBURETORS is checked with rotameters under all conditions of operation

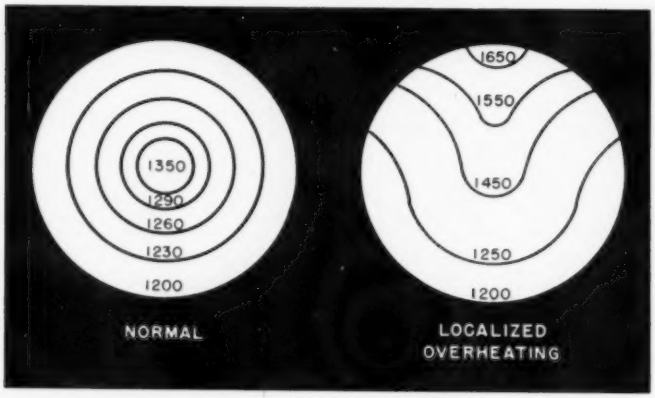


FIG. 4—TEMPERATURE PATTERNS of valve heads in degrees F. (courtesy Thompson Products, Inc.)

to such details is necessary to obtain acceptable test results.

The highway used in the road tests is the normal inter-city truck route, which winds through the foothills of the mountains near Los Angeles. These hills provide long, steady up-grades at full throttle, rolling hills with accompanying full and closed throttle positions, and moderate downgrade running. There is also considerable stop and go driving, since the route passes through many cities. The course covers 208 miles per round trip and requires one 8-hour shift per circuit.

The engines are operated at three-quarters to full throttle for approximately 70% of the time, which gives an idea of the severity of the test. The average speed is 37 miles an hour with a maximum of 55. The average engine speed is 2600 rpm. Coolant temperature is controlled at 180° F. and the oil temperature reaches equilibrium at approximately 215° F. A standard 2-104b oil is used with 5,000 mile oil drains.

Preparing Engine for Test

New engines are used for each test and they are completely disassembled and measured prior to testing. Cylinder bore measurements are made with an accurate dial gauge calibrated in 0.0001 in. With the exception of gears, most parts subject to wear are measured to similar accuracies. Extreme care is observed when reassembling engines to insure conformance to factory specifications; extra precautions are observed and tolerances narrower than factory requirements are used in fitting up many parts, particularly valves, carburetors, and distributors.

New valves are used for each test and when necessary they are refaced, prior to use, to obtain a maximum run out of 0.0005 in. Fig. 2 shows the device used to check the valve faces for concentricity. A jig for checking the concentricity of the valve guides and seats in the cylinder head, is shown in Fig. 3. This device is piloted on the guide and has a finger which rides on the valve seat to indicate run out. Concentricity is carefully controlled to a total run out of less than 0.001 in. Guide clearances are set at the low limit of factory specifications to obtain uniform stem cooling.

Another special precaution observed in connection with the valves is valve spring tension. Valve spring sets are balanced to within ±1 pound tension for each engine. Tappet clearances must be adjusted after the first 1000 miles to compensate for shrinkage of cylinder head gasket and clearances are checked at 5000 mile intervals thereafter.

It may seem that extreme measures are used in maintaining the dimensional tolerances of valves, but valve behavior is one of the important aspects of the test work and it is believed necessary to exercise the closest possible control over valve fits and clearance. The importance of some of these dimensions are well illustrated by the following data developed by Thompson Products, Inc.

Fig. 4 shows two temperature patterns of a valve head. The one indicated as normal represents a temperature pattern which might be generally expected in typical operation. Current automotive valve materials

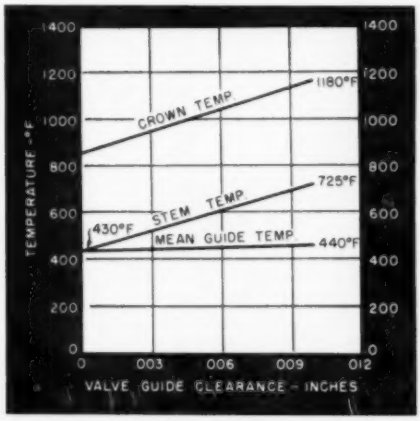


FIG. 5—EFFECT OF VALVE GUIDE CLEARANCE on valve temperature (courtesy Thompson Products, Inc.)

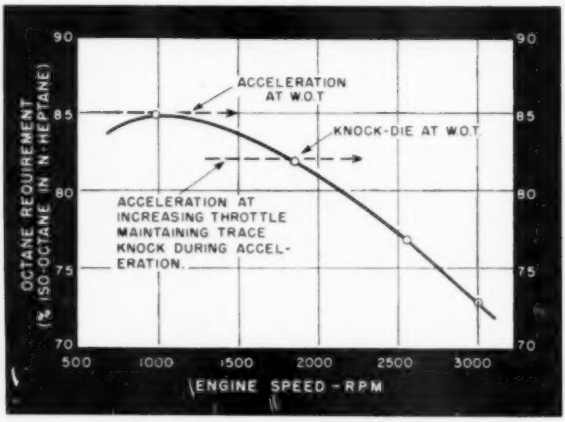


FIG. 6—METHOD FOR DETERMINING OCTANE requirements with minimum disturbances of combustion chamber deposits

will usually operate satisfactorily and can resist the action of the hot exhaust gases when this temperature pattern exists. If, for some reason, a leak occurs through block distortion or non-concentricity of the valve and seat, a rapid temperature rise occurs as indicated on the right. Under these conditions, the valve loses its ability to withstand the action of the exhaust gases and the valve soon burns out. Fig. 5 shows how guide clearances can also affect the head temperature and, consequently, the life of the valve. This shows the effect of guide clearances on valve head temperature, stem temperature, and mean guide temperature. A change of 0.003 in. in guide clearance can mean a change in head temperature of 100° F. This indicates the importance of maintaining accurate valve guide clearances, particularly when it is realized that 50° change in valve head temperature may mean the difference between satisfactory performance and rapid destruction.

The photograph on the second page of this article shows the instrumentation used to check the fuel flow characteristics of the carburetors. It has been found necessary to check the carburetors frequently during the course of the test, since vibration and wear frequently upset initial settings. Rotameters have been found more convenient than instrumentation which requires timing of a given volume of fuel. Fuel flow characteristics are checked over the entire speed range, not only at idle, as shown in this photograph, but also during full throttle level road operation.

Method of Determining Octane Number Requirements

One of the important factors studied in the road tests is the effect of combustion chamber deposits on octane number requirements increase. Considerable work was done on methods for determining these changes in the engine with mileage. Level road accelerations and up-hill full throttle techniques were investigated with and without the trailer load. The differences in results with various techniques were insignificant and Fig. 6 illustrates the essentials of the knock testing technique finally adopted. This method, in addition to its simplicity, prevents the engine from operating under severe detonating conditions. This was desired to minimize the disturbance of combustion chamber deposits during knock tests.

The engine is first adjusted to manufacturer's standards and operated until equilibrium temperatures are obtained. Then, starting with a primary reference fuel above the maximum requirements of the engine, full throttle, level road, accelerations are made using reference fuels of progressively lower octane (3 O.N. brackets) number until the fuel is found, or interpolated, which gives trace knock. This maximum requirement usually occurs at 1000 rpm.

Accelerations are then made with lower octane reference fuels at gradually increasing throttle, maintaining trace knock throughout the acceleration. The speed at which the knock dies out at full throttle defines the full throttle knock die-out curve and establishes the octane requirement of the engine throughout the speed range.

The following describes some of the results obtained in convoy operated tests. It should be borne in mind that in all tests, six vehicles were used, with three of the vehicles on one fuel and three on another. Fuels were of the commercial type, containing "cat"-cracked, thermal-cracked, alkylate, and straight-run stocks.

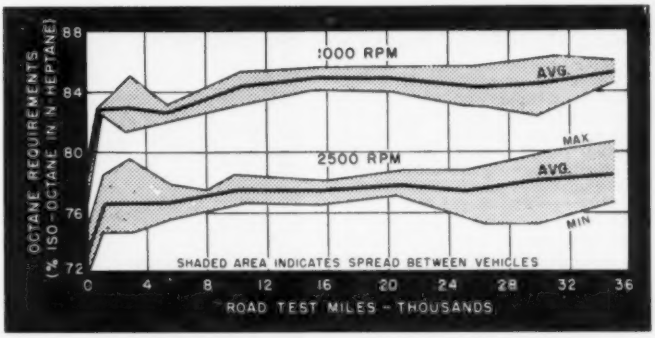


FIG. 7—AVERAGE OCTANE requirements for six vehicles at 1000 and 2500 rpm

Octane Requirements

Using the technique just described, octane requirements determinations are made at regular periods during a 35,000 mile test. Fig. 7 shows typical results obtained on six trucks operated on the same fuel. It will be

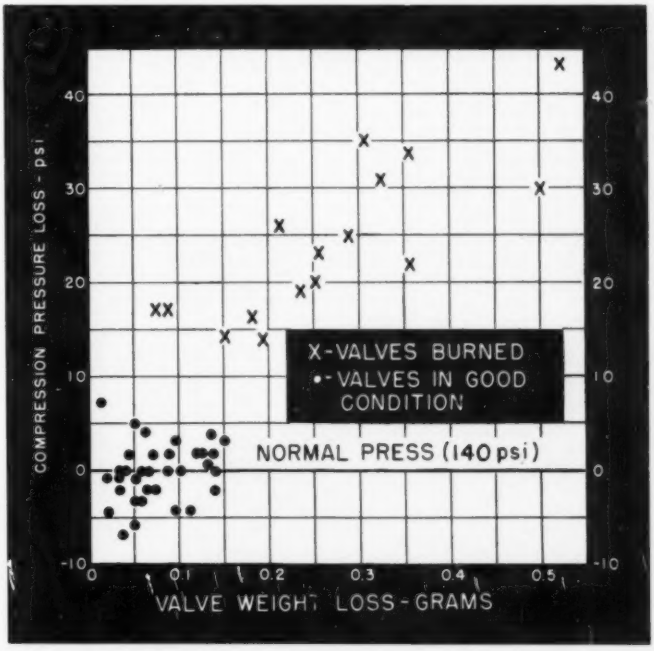


FIG. 8—CORRELATION between compression pressure loss, weight loss, and condition of exhaust valves

noted that reproducibility from truck to truck is very good, with a spread between vehicles of only two to four octane numbers. It is interesting to notice the very rapid increase in octane requirement during the first 1000 miles, followed by a very gradual increase to equilibrium at approximately 10,000 to 12,000 miles. The overall average octane requirements increase at 1000 rpm is seven octanes. At 2500 rpm the spread between vehicles is about the same and the octane requirement increase at this speed is on the order of five octane numbers in 35,000 miles. These data indicate the excellent degree of reproducibility which can be obtained by convoy operation of road test fleets if sufficient attention is paid to details.

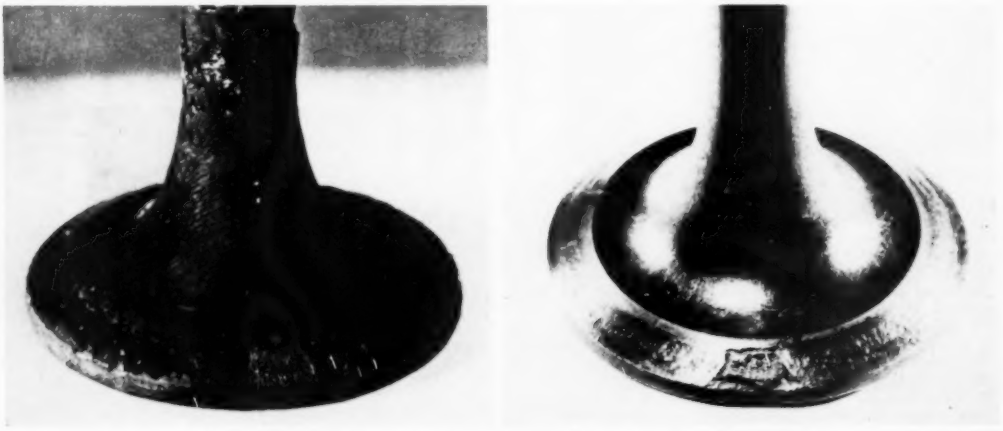
Valve Behavior

A second important performance characteristic observed in these tests is valve burning. Everyone who has conducted valve burning tests knows the difficulty of obtaining reproducible results from test to test even in laboratory engines. As will be shown, the degree of reproducibility that can be obtained in very carefully conducted road tests is surprisingly good, considering that the tests are conducted under service conditions.

The first problem that confronts the test engineer is how to determine when a valve is burned. Furthermore, what is a burned valve? In these tests a burned valve is one which, when cleaned electrolytically, shows guttering or metal removal from the valve seat. An example of a burned valve is shown by the photographs on the bottom of this page. On the left is shown a burned valve as removed from the engine; guttering has occurred on the seat and the valve head shows evidence of overheating. This same valve, after electrolytic cleaning, is shown on the right. Here the guttering of the seat and results of overheating of the head can readily be seen.

TEST ROUTE selected for use includes both mountainous terrain and . . .

To return to the first problem of how to determine when a valve is burned, experience in these tests and in the laboratory has indicated that burned valves can be detected when the compression pressure loss in any one cylinder exceeds 10% (14 psi for these engines) of its normal pres-



LEFT: A TYPICAL BURNED VALVE as removed from the engine. At right is the same valve after electrolytic cleaning

. . . stretches of foothills, typical of a normal inter-city trucking route

sure for an eight-hour period. This is demonstrated in Fig. 8 which shows the correlation between compression pressure loss, weight loss, and condition of exhaust valves.

It will be noted that data for all valves which were in good operating condition, and show no signs of burning, are concentrated in the lower left hand portion of the figure. These valves show low weight losses and compression pressure losses of less than 10 psi. On the other hand, when the sustained compression pressure losses reach 14 psi or over, the valves were found to be guttered and the weight losses were correspondingly higher.

It is believed that these data indicate that a satisfactory criterion of a burned valve is a sustained compression pressure loss of 10% or more over an eight-hour period.

In conducting valve burning tests it has been found expedient to operate the vehicles until two valves have been burned in each engine. When the first valve is burned it is replaced and the operation is continued until the second valve failure occurs. The second valve failure serves as a check that group averages can be used with more confidence in making comparisons. These first two valve failures usually occur at mileages quite close to one another, although there are occasional stray results with large variations.

In general, it is indicated that differences in group averages must be, at least, greater than 5000 miles, and preferably more, before any significance can be attached to the results. Fortunately, this is a satisfactory degree of reproducibility because any method used to correct valve burning must produce considerably better than 5000 miles improvement to be significant in terms of service operation.

Cylinder Bore Wear

Fig. 9 shows the average cylinder wear at various locations of the bore for six engines operated in convoy for 35,000 miles. Three of the vehicles were operated on one fuel and three on another, as shown in the figure the data of the individual engines overlap and is it not possible to distinguish differences between the two fuels. It will be noted that the spread between vehicles on the same fuel is only on the order of 0.001 in. or less. This degree of reproducibility is satisfactory for the investigation of factor affecting cylinder bore wear. However, differences in wear will probably have to be consistently greater than 0.002 in. before results can be considered significant.

It may be of interest to comment that in all 36 cylinders of these engines, the wear was very uniform around the circumference of the bores. At the top of top ring travel, which is the point of maximum metal loss, the wear measurements parallel to the wrist pin were within 0.0003 in. of the wear at right angles to the pin.

Piston Ring Wear

Fig. 10 shows the piston ring wear corresponding to the bore wear just discussed. In order to obtain maximum accuracy, wear was measured in terms of weight loss determined with a sensitive laboratory balance. The data have been segregated to show the piston ring weight loss as an average for each engine, for the top, middle, the bottom ring; in the three sets of charts the group on the left represent results with one fuel and those on the right represent the results with another fuel.

As with the bore wear, there is no significant difference in piston ring wear between the two fuels and the data show a very close degree of reproducibility. In the case of the top two compression rings, the maximum deviation from the group overage was seventeen per cent. The oil rings show a maximum deviation between engines of 25%.

Meet the Author

I. T. Rosenlund, as automotive technologist in the petroleum chemicals division of the du Pont Co. at Wilmington, Del., is concerned with tractor, bus, truck, and automotive operational problems. He received his B.S. in engineering from the University of Michigan in 1937. His work with fuels and lubricants started at the Beacon, N. Y., research laboratory of The Texas Co. in 1938. He was later with the Allison Division, General Motors Corp., and with Packard Motor Co., where among other duties he was project engineer on jet engine combustion chamber design. He has been with du Pont since 1947, and was manager of the company's West Coast Road Test Laboratory in El Monte, Calif.

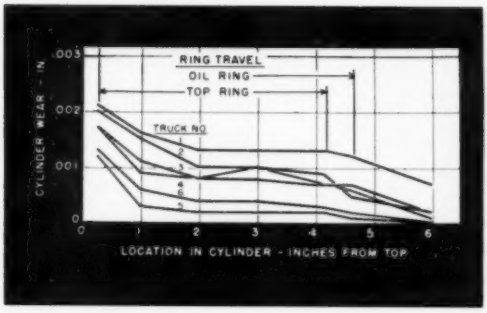


FIG. 9—CYLINDER BORE WEAR in individual engines operated in simultaneous convoy tests for 35,000 miles

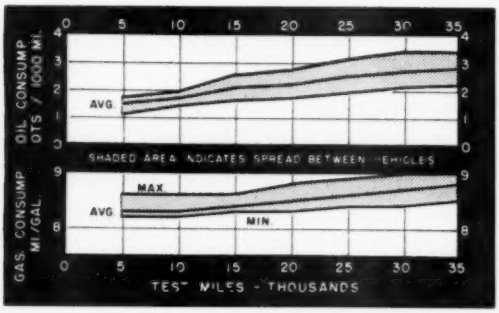


FIG. 11—AVERAGE CONSUMPTION of fuel and oil in one typical convoy test with six trucks

These deviations are sufficiently low to indicate that this test technique can be used satisfactorily for investigating piston ring wear, as well as cylinder bore wear.

Fuel and Oil Consumption

Fig. 11 shows the average fuel and oil consumption for all vehicles during one typical test. The shaded areas again represent the spread between vehicles. The oil consumption gradually increased in 35,000 miles from 1.5 quarts per 1000 miles to 2.8-quarts per 1000 miles. The maximum difference between vehicles was one quart per 1000 miles.

The average gasoline consumption varied from 8.3 miles per gallon at the start to 8.8 at the completion of the test. The maximum variation between vehicles was 0.5 miles per gallon or approximately 6%. It should be mentioned that oil consumption and fuel-air ratio must be controlled in tests designed to yield information on octane requirement increase and valve burning. These tests show a satisfactory degree of control of fuel and oil consumption and it is believed that the uniformity from vehicle to vehicle is in no small measure due to careful assembly of engines, with meticulous attention to fits and clearances and frequent checking of carburetors.

Because of the use of 2-104b oil, all engines used in the road test work from the standpoint of sludge deposits were relatively clean.

Summary

No effort has been made to discuss the effects of antiknock agents, commercial or experimental, on the performance of vehicles. An attempt has been made to show the value of fleet work of this type as a reproducible method for investigating differences resulting from fuel variables. It is believed that experimental compounds which show promise in convoy operated tests can be released for further proof testing in commercial operations with considerable assurance of satisfactory performance. The tests also show that uniformly good performance can be obtained by paying close attention to maintenance techniques.

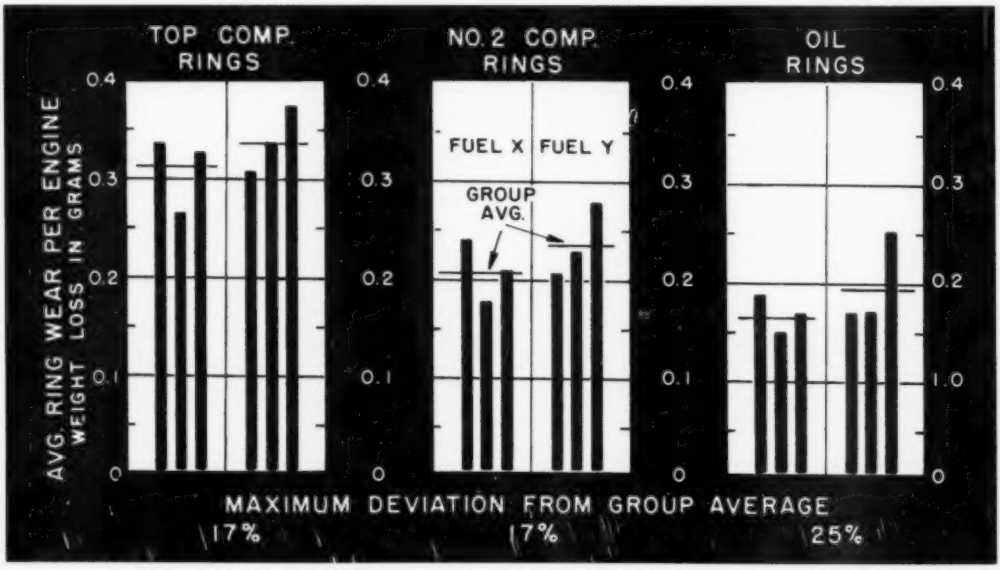


FIG. 10—PISTON RING WEAR in individual engines operated in the convoy tests

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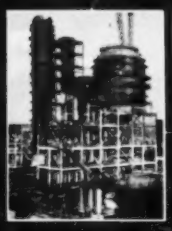

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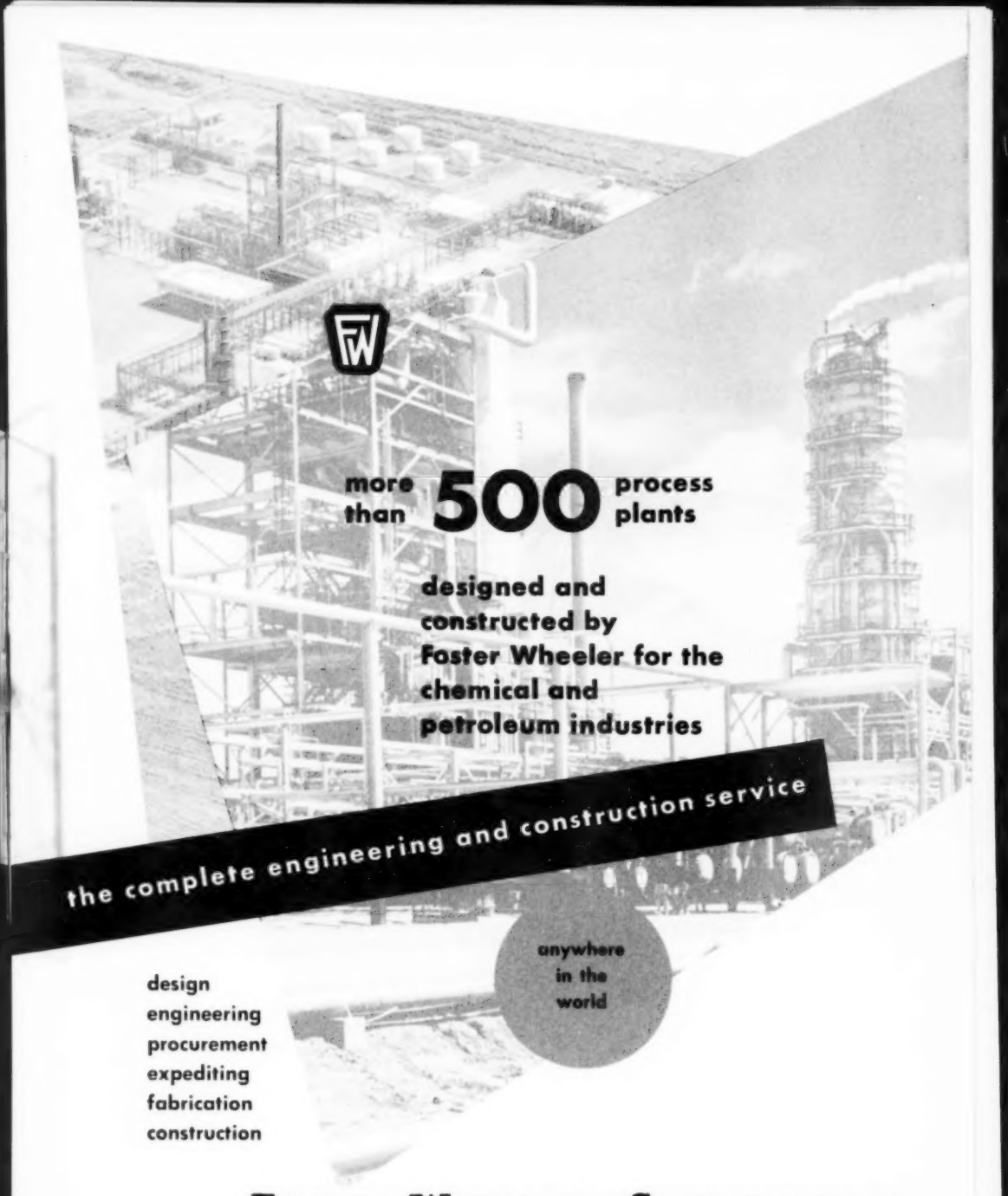

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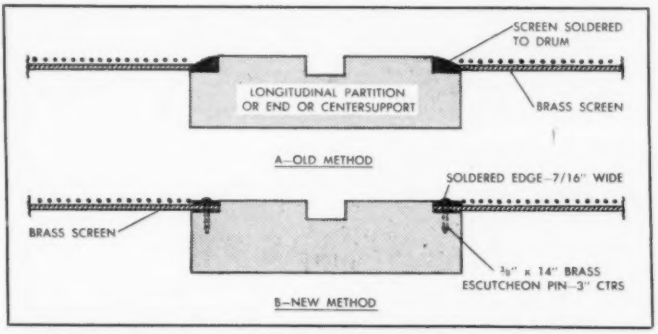

FIG. 1—NEW and OLD methods for fastening screen panels to filter drums

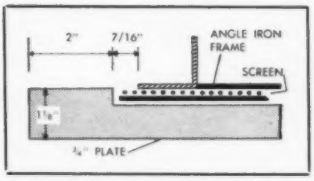

FIG. 2—Detail of method for forming the solder band

A total of 500 man-hours is saved, and a hazardous job of moving a heavy filter drum has been eliminated by means of an improved method for replacing the brass back-up screen panels on rotary wax filters at the Olean, N. Y., refinery of Socony-Vacuum Oil Co., Inc.

The drum (in a Wright-Goslin type filter) is 16 ft., 2 in. long by 10 ft., 1 in. diameter and weighs an estimated 19 tons. It is installed on the second floor of the filter building, about 18 ft. above ground level.

In the former maintenance practice, it was removed from its tank and lowered to the ground into an especially constructed cradle. Because of the hazardous location, the drum then had to be moved out of the area to the shops. There the existing back-up screen panels had to be replaced, a total of 56 panels measuring 11¾ x 93¾ in. New panels were then installed by soldering new brass screen cloth (mesh, 7 x 7 x 0.041 in. diameter) to the longitudinal partitions and the end and center supports of the drum, as shown in detail A in Fig. 1. Then the drum was taken back and raised into position in the filter.

The new procedure provides for making up a set of 56 screen panels to the proper dimensions, each with a 7/16-in. wide band of solder around all four edges. The drum is left in place in its tank. The old panels are removed, the drum being rotated slowly to permit the complete operation. The new screens are then laid in place and fastened as illustrated in detail B, Fig. 1. Holes are drilled, with a No. 45 bit on 3-in. centers, through the solder band and into the brass partitions and supports on the drum. Brass escutcheon pins, ⅜-in. x No. 14, are then driven in to hold the panel in place.

Solder-edge bands are made on the panels in the shop ahead of time using a simple, two-piece jig, see detail in Fig. 2. A bottom mold consists of a piece of ¾-in. plate, 98 x 14 in., with a raised edge 2 in. wide and ⅜ in. high. This provides a space measuring 94 x 12 in. to receive the screen panel.

The upper "mold" is a frame 93⅛ in. x 11⅛ in. overall, made of 2½ x 2½ x ¼ in. angle iron, with the legs of the angle facing outwardly and upwardly. This frame is clamped down over the wire screen, thus allowing a 7/16-in. wide space around the edges of the frame for soldering the 7/16-in. band to the screen.

Safety is assured with the new method since (1) no soldering is done in the filter building, (2) all fastening involves pneumatic tools and brass hammers, and (3) no dangerous rigging and moving of heavy equipment is necessary. The large saving in man-hours can be attributed chiefly to leaving the drum in place for the job.

This method was the result of a suggestion by Albert A. Hoffman, Olean employe.

Low Pressure Switch Is Made from Pneumatic Receiver Bellows Assembly

IN regular instrument parts stock there are often a number of parts that can be very easily adapted to services for which they never were intended. One of the more versatile is the receiver bellows assembly such as is used in Taylor or Brown pneumatic receivers.

For example, an instrumentman may need a low pressure switch for some application such as lock-out or signalling, and he doesn't have the proper switch on hand. By simply mounting a Taylor or Brown receiving bellows assembly on a home-made base plate and arranging one or more microswitches to be tripped by the bellows arm, he will have a very dependable pressure switch that can be set to very narrow limits.

The entire assembly can be mounted in an explosion-proof housing and used in a hazardous area. The homemade assemblies have been found more dependable and trouble-free than many purchased assemblies. By proper selection of microswitches and adjustment with relation to the bellows actuating arm, these switches can be hooked up to the air output from standard pneumatic transmitters, level controllers, and the like. They can actuate lights and/or sound signals, to show high and low level, high and

low flow rates, high and low pressures, etc.; or actually operate lockouts and cut-ins or other safety devices to maintain safe operation or bring an operation back to normal.

This item is based upon information in the paper "Gadgeteering" by J. M. Jones, Jr., The Texas Co., Port Arthur Works, presented at the 1949 *symposium on Instrumentation for the Process Industries at Texas A&M College. A major portion of the paper appeared in* PETROLEUM PROCESSING, *March,* 1951, *pages* 275-278.

Insulation Helps to Prevent Corrosion in Boiler Devices

CORROSION of equipment due to condensation of moisture from hot gases can be avoided by insulating the heated equipment, according to a recent news release by the Magnesia Insulation Manufacturers Association. A typical use of insulation for this purpose was an installation at a steam plant of a Baltimore public utility, but the method could be employed in any steam plant.

To prevent air pollution by smoke from the boilers, huge dust collectors clean the smoke before it goes out through the stacks. The temperature of the metal dust collector shells must be kept between 280 and 300° F., since condensation and the resulting corrosion would increase maintenance requirements and reduce the life of the collectors.

This temperature control was achieved by insulating the collectors with a layer of 1½-in. thick 85% magnesia blocks. The insulation was applied over 6 x 6-in. wire mesh, welded to the exposed angle stiffeners of the collector shells. A layer of 1½-in. hexagonal wire mesh was then applied, and covered with a ½-in. thick layer of asbestos cement. Because the installation is out of doors, the insulation was given a weather resistant finish. A layer of 1-in. hexagonal wire mesh was stretched over the asbestos cement, over which asphaltic asbestos plastic was troweled on.

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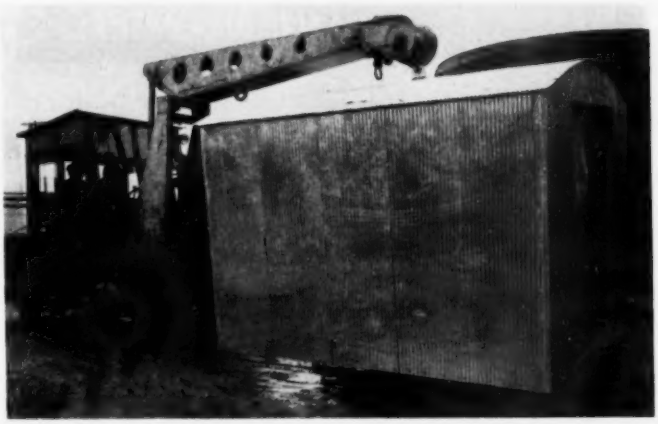

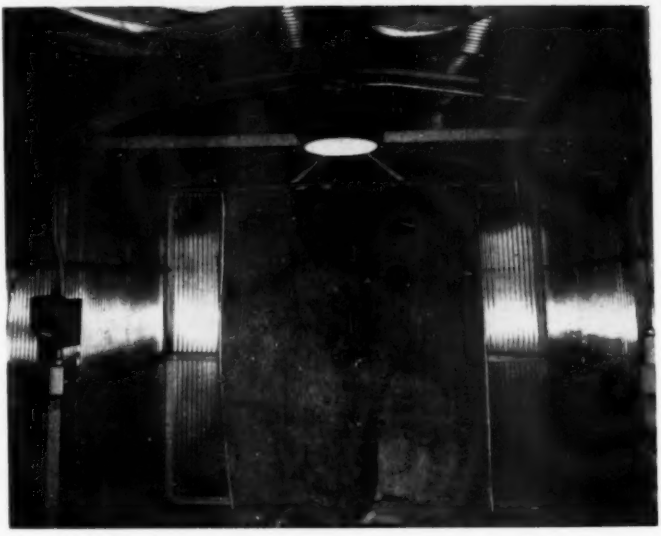

Portable, Floor-less, Metal Shanties Shield Maintenance Men from Weather

IN order to provide adequate weather protection for workmen in the refinery maintenance forces, Sinclair Refining Co. at its East Chicago plant has constructed shelters which can be moved quickly to any location.

The shelter, shown in the photographs, is 8 x 10 x 6½ ft. high at the eaves. It has a 2 x 2-in. angle iron frame, is covered by corrugated aluminum sheeting, and has no floor. Asbestos curtains are fitted to rings hanging over a round bar at each end of the shelter and are used to close the 4 x 6 ft. openings. A permanent overhead light, outlet, and steam coil are available for furnishing light and heat.

The shelters are easily transported from place to place in the refinery property by means of a "Hyster" truck or similar equipment. They have a flat bar, with a hole for a hook, welded to the roof at the center so the building is in balance when being moved.

Because refinery maintenance forces are required to work night or day in all kinds of weather, this shelter has found many applications. It has been particularly useful for welders.

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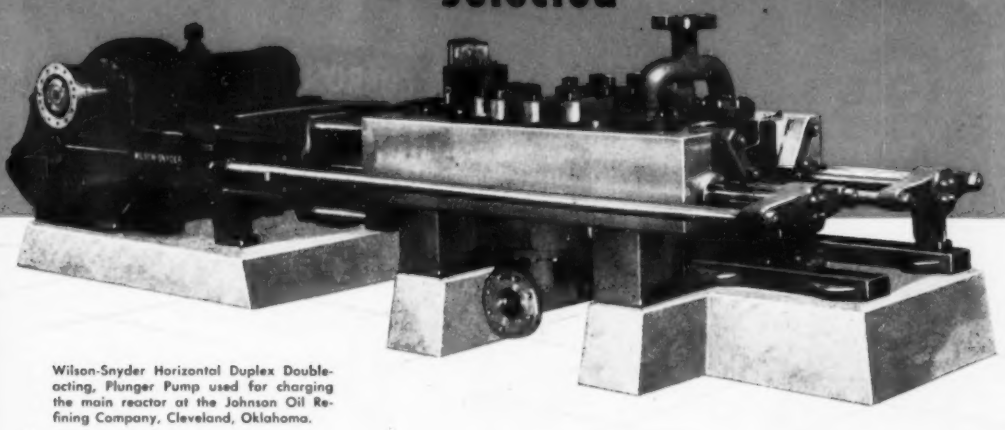

Wilson-Snyder Horizontal Duplex Double-acting, Plunger Pump used for charging the main reactor at the Johnson Oil Refining Company, Cleveland, Oklahoma.

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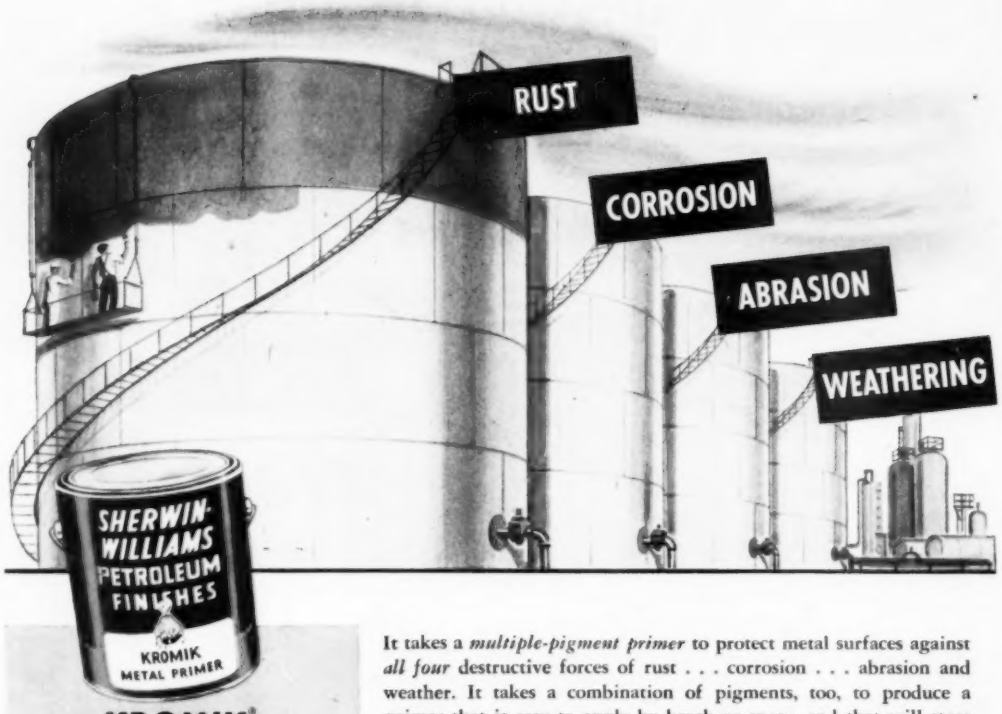

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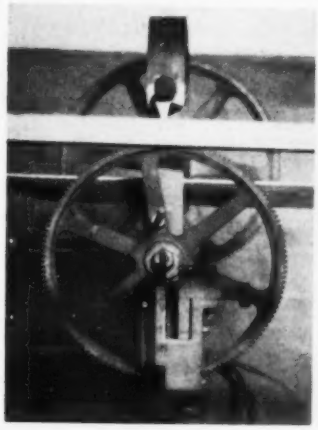
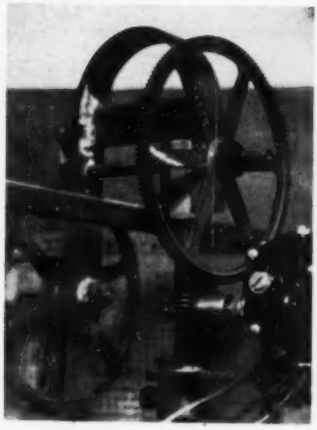
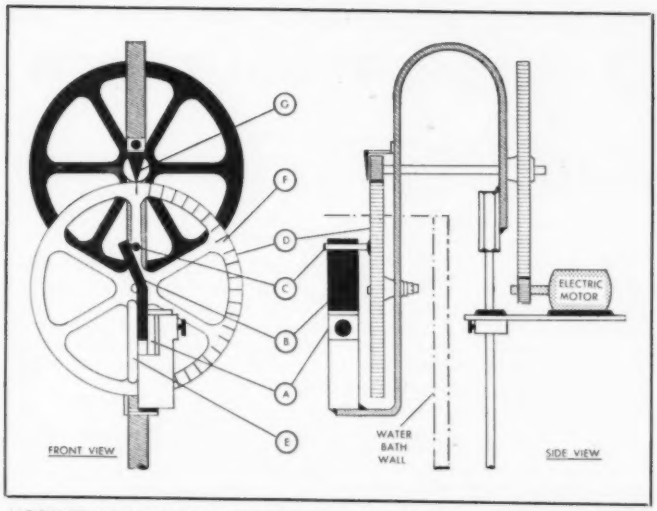




Motor-Driven Unit Improves Asphalt Pliability Test Runs



MODIFIED ASPHALT TEST APPARATUS based on the Reeve and Yeager pliability determination method

MODIFICATIONS in a standard test apparatus for determining pliability of asphaltic materials—roofing cloth, paper, and the like—have permitted running the test at a precisely constant speed and changing the time cycle if desired. As worked out in the laboratory at the Linden, N. J., refinery of Cities Service Oil Co., the alterations consisted of replacing the manually-operated handle of a Reeve and Yeager tester with a suitable electric motor and reducing gears, as illustrated in the accompanying sketch and accompanying photographs.

The essential parts of the apparatus are: the clamp *A*, holding the strip of roofing *B*, and the large gear wheel *D* carrying a pin *C*, one inch distant from its center and projecting perpendicularly from its surface. Clamp *A* is designed to hold the lower two inches of a roofing specimen, four inches long and one inch wide. This clamp is located directly in front of gear wheel *D* so that the back of the clamp, the top of which is rounded to a $\frac{1}{16}$-in. radius, serves as a mandrel *E*, located on the central line of the bearing on which gear wheel *D* revolves. In that way, pin *C* and the mandrel *E* are parallel.

When a strip of roofing is held in the clamp, rotation of gear wheel *D* brings pin *C* into contact with that part of the strip projecting above the clamp. By continuing the rotation, the pin causes the strip *B* to bend around the mandrel *E*. The limit of the rotation is reached when the strip has been bent double over the mandrel, practically equivalent to 180° of bend.

The angle through which the strip is bent is measured by means of a protractor *F*, graduated in degrees and fixed to wheel *D* in the proper position. In starting a test, the pin is brought into contact with the strip of roofing when it is in a vertical position, and the pointer *G* is adjusted to indicate zero. This provides for roofing specimens of different thicknesses requiring slightly different initial positions of the gear wheel *D*.

As will be seen in the side view, the upper surface of the strip at the point where the bending takes place is at all times clearly visible, so that the development of a break in the coating is readily discerned. When this occurs, the motion of the machine is stopped, and the angle of bending is read by the indicator and protractor. This value is recorded as a measure of the pliability of the roofing. Rate of turning is usually controlled to a speed of 180° in 30 seconds.

To secure reproducible results, test temperature is maintained by the water bath. The test apparatus assembly is carried on an adjustable vertical support for lowering into the bath.

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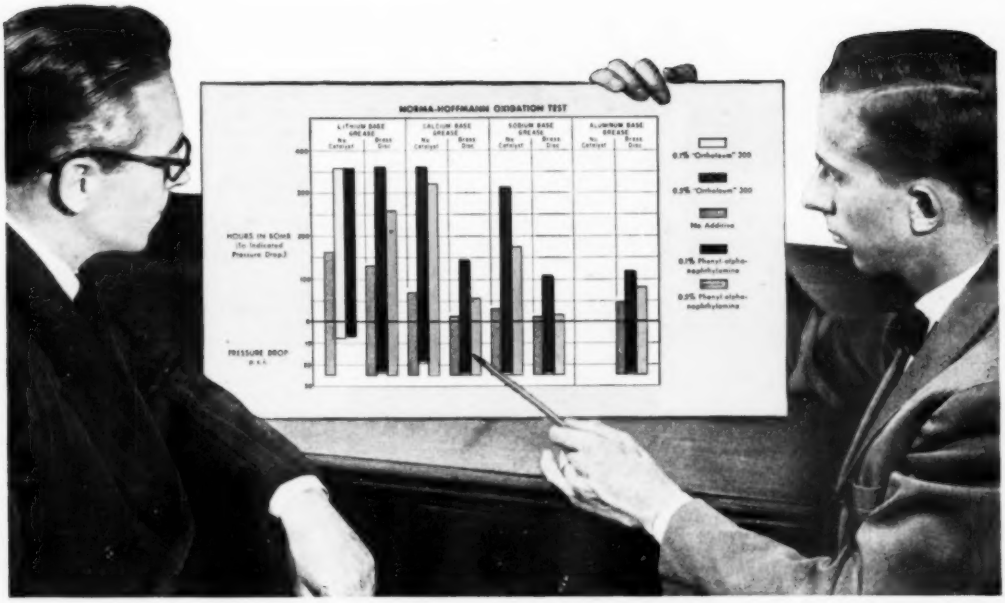

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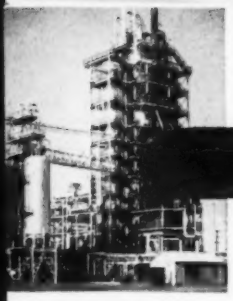

PROCESSING PATENTS

New Developments in Processes and Products

By PETER J. GAYLOR
Editor, "The Technical Survey"

Solvent Fractionation Of Wax Mixtures

A METHOD for deoiling hydrocarbon waxes, particularly those containing not over 70% oil, is described in U. S. Patent 2,541,338 issued to Atlantic Refining Co. It involves separating a material such as slack wax into fractions of different melting points by use of an extraction solvent followed by partially-immiscible additives at temperatures such that two phases are formed, one containing the higher melting wax, and the other containing the lower melting wax, together with the major proportion of solvent and additive. Success of the process depends on the control of temperature in the extraction zone and upon regulation of proportions of solvent and additive.

A flow sheet of the process is illustrated in Fig. 1. The waxy feed, such as slack wax, is continuously introduced in liquid condition at the rate of 100 volumes per hour through pipe 2 into extraction tower 1. An extraction solvent, such as nitrobenzene containing 2% ethylene glycol mono-methyl ether is continuously introduced from tank 3 into the top of tower 1 where it flows countercurrent to the wax stream at the rate of 200 volumes per hour.

The first additive, which is preferably ethylene glycol monomethyl ether, is introduced from tank 6 through line 7 into tank 1 at a rate of 20 volumes per hour. The second additive, which is acetone containing 5% water, is continuously introduced from tank 9 into pipe 8 at a rate of 90 volumes per hour. A temperature gradient is maintained in the tower by means of coils 11 through which a heating or cooling medium is circulated, the top portion of the tower being higher than that of the bottom portion. The contents of the tower are entirely in liquid phase.

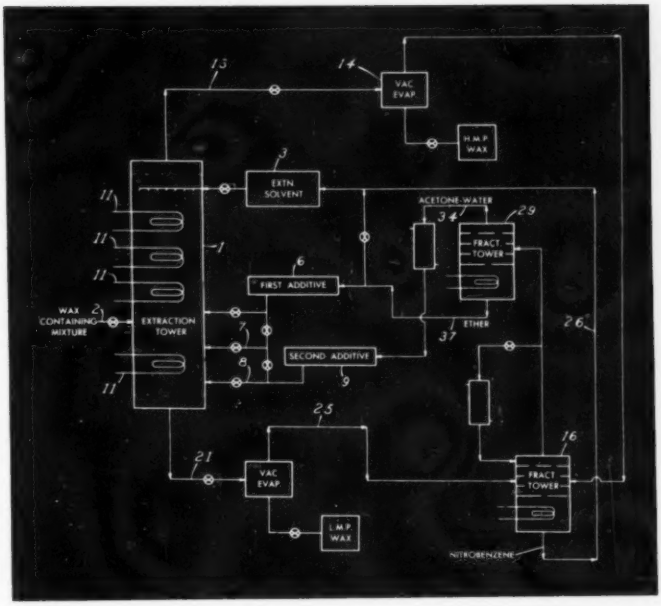

FIG. 1—Flow chart for solvent fractionation of wax mixtures, as developed by Atlantic Refining Co. (U. S. Patent 2,541,338)

The wax stock, being subjected to the action of the solvent and additives, is caused to separate by solvent action into a fraction containing a high melting wax which passes upwardly through the tower, and a fraction containing a low melting wax which is drawn off through line 21. The high melting wax mixture drawn off through line 13 is subjected to vacuum evaporation in still 14, from which the high melting wax is recovered as bottoms, while the solvent is fractionated, first in tower 16 to recover nitrobenzene as bottoms (line 26), then in tower 29 from which the ether is removed through bottoms line 37, while the acetone water mixture is taken off overhead through line 34. Solvent recovered from the low melting wax (line 25) is run into tower 16, also.

Typical results obtained in this manner from a slack wax feed stock are shown in Table 1.

TABLE 1—Typical Results for Solvent Fractionation of Wax Mixtures (U. S. Patent 2,541,338)

	Charge Wax	Raffinate Wax	Extract Wax
Weight Percent Yield	100%	50.3%	49.7%
Melting Point, °F.	113.1	127.9	94.3.
Oil Content, Wt. Percent	24.2	0.3	48.5.
Refractive Index at 176° F.	1.43625	1.43120	1.44570.
A. P. I. Gravity	40.5	41.3	36.5.
Color	Brown	White	Dark Brown.
Firmness	Nil	Good	Nil.
Tackiness	Poor	Good	Poor.
Plasticity	Too Soft	Good	Too Soft.
Fiber Length	Short	Long	Short.
Flexibility	Poor	Good	Nil.

Stabilizing Gasolines

IN the case of catalytically cracked gasoline, there generally is only a small amount of aliphatic mercaptans present, but a relatively large amount of aromatic mercaptans. One patent (U. S. 2,525,152) issued to Standard Oil Development Co. reports the discovery that, when oxygen is present, oxidation of olefins and diolefins in the gasoline is catalyzed by the presence of these aromatic mercaptans. The olefins and

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diolefins oxidize to peroxides which, in turn, destroy the aromatic mercaptans and produce excessive gum.

The patent advocates removal of the aromatic mercaptans with caustic of 5 to 40° Be gravity in amount of 5% to 20% by volume of the gasoline, precaution being taken to exclude all air or oxygen during the removal operation.

Extraction of Olefins With Silver Salts

ONE patent issued to Shell Development Corp. (U. S. 2,523,681) describes a method for separating unsaturated hydrocarbons from hydrocarbon mixtures by extraction with a solution of silver nitrate in water and phenol wherein the silver nitrate and phenol are in the weight ratio of about 1:2 and containing about 10-22% by weight of water.

Extraction of catalytically cracked gasoline containing 42 volume % of 5-carbon olefins at 60° F. and atmospheric pressure, using extractive solvent volume ratios of 0.15-0.40, resulted in absorption of 11.4% olefins with about 95% purity.

Two-Stage Reforming Process Produces Pure Toluene

SUBSTANTIALLY pure nitration grade toluene is claimed to be produced readily and economically from straight chain or aliphatic hydrocarbons occurring in petroleum fractions. A patent issued to M. W. Kellogg Co. (U. S. 2,545,153) discloses production of toluene in conjunction with the production of high antiknock motor fuel.

In this process, naphtha is contacted at elevated temperature with a dehydrogenating-cyclyzing catalyst in presence of added hydrogen. The highly aromatic product obtained is separated into an intermediate fraction rich in toluene, and higher and lower boiling fractions which may be blended to produce a high antiknock motor fuel. Then, the toluene fraction is contacted in a second stage with a dehydrogenating-cyclyzing catalyst under more drastic conditions than in the first stage, to convert nonaromatic components of the fraction to aromatics. Pure toluene is separated from these aromatics by fractional distillation or by other methods.

A diagrammatic flowsheet of the process is depicted in Fig. 2. Virgin naphtha in the C_{6-12} range is fed in through line 1 after which it is mixed with recycle hydrogen from line 5, heated in coil 3 and passed through catalyst tower 7 containing molybdenum oxide supported on activated alumina. Conversion products are withdrawn through line 8, cooled in condenser 9, and passed into high pressure separator 10, which separates the gaseous and liquid components.

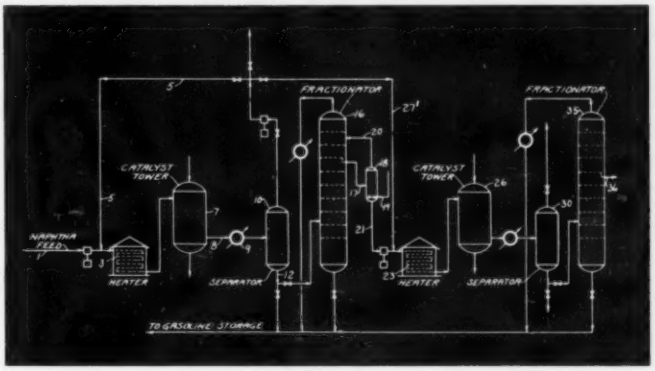

FIG. 2—Toluene production involving retreating at more severe conditions. (M. W. Kellogg Co., U. S. Patent 2,545,153)

The liquid product from line 12 is passed to fractionator 16, where as large a proportion of toluene as may be satisfactorily separated is withdrawn as a side stream through pipe 17 and passed to a side stream stripper 18. Steam is supplied through line 19 to further increase the concentration of toluene by removing light components, which are withdrawn through line 20 and returned to the fractionator. Thus, a fraction relatively rich in toluene (50-75% or more) is withdrawn through line 21 and pumped into coil 23 with recycle hydrogen from line 27 and then passed through catalyst tower 26, after which gas is separated in separator 30 and the liquid is fractionated in rectifier 35, the pure toluene being removed as a cut through line 36.

When a 44 octane number naphtha of 240° F. initial and 418° F. end points (51.4° API) is treated in this manner, the conditions in catalyst tower 7 are as follows:

Inlet reactor temperature	1015° F.
Outlet reactor temperature	925° F.
Pressure	300 psi
Feed rate, vols. Naphtha/hr./vol. catalyst	2.75
Hydrogen gas recycle, cf/bbl. Naphtha	2600
Length of on-stream period	6 hrs.

From this operation, a highly aromatic gasoline of 80 CFRM octane number was obtained, toluene content being 7.5% by volume. The operating conditions for reactor 26, when treating a fraction containing 75% toluene and 25% other hydrocarbons in the 200°-240° F. boiling range, would be as follows:

Average reactor temperature	1000° F.
Pressure	300 psi
Feed rate	0.25
Hydrogen gas recycle	2600
Length of on-stream period	6 hrs.

Patents Issued in March

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for March 6, 13, 20 and 27, Vol. 644, Nos. 1-4.

Chemicals

U.S. 2,543,820 (Standard Oil Development Co.)—Secondary alcohols from olefins.

U.S. 2,543,842 (Phillips Petroleum Co.)—Polysulfone resin.

U.S. 2,543,844-5 & 67 (Phillips Petroleum Co.)—Plasticizing synthetic rubber with mercaptan reaction product.

U.S. 2,543,859 (Standard Oil Development Co.)—Analyzing by mass spectrometry.

U.S. 2,544,271 (Shell Development Co.)—Oxygenated products from petroleum.

U.S. 2,544,294 (Socony-Vacuum Oil Co.)—3-Thienyl sulfides.

U.S. 2,544,392 (Shell Development Co.)—Base-catalyzed vapor-phase production of ethers from alcohols and olefins.

U.S. 2,544,552 (Phillips Petroleum Co.)—Drying oils by treating of acid-soluble oils with HF.

U.S. 2,544,555 (Phillips Petroleum Co.)—Reacting diolefin polymers with hydrogen and carbon monoxide.

U.S. 2,544,562 (Stanolind Oil & Gas Co.)—Recovering aldehydes and ketones.

U.S. 2,544,564 (Phillips Petroleum Co.)—Preventing foaming of ethanolamines with stearyl alcohol in isopropanol.

U.S. 2,544,818 (Phillips Petroleum Co.)—Alkylating phenols.

U.S. 2,544,823 (Universal Oil Products Co.)—N-(hydroxy aryl) pyrrolines and pyrrolidines.

U.S. 2,545,144 (Standard Oil Development Co.)—High molecular weight polymer production.

U.S. 2,545,153 (M. W. Kellogg Co.)—Aromatics (toluene) from petroleum distillates.

U.S. 2,545,161 (Standard Oil Development Co.)—Ethyl alcohol.

U.S. 2,545,182-3 (Shell Development Co.)—Polyallyl type alcohols from formates.

U.S. 2,545,184 (Shell Development Co.)—Diallyl esters and polymers.

U.S. 2,545,516 (Standard Oil Development Co.)—Diolefin—nitrile copolymer plasticized with hydrocarbon polymer.

U.S. 2,545,522 (Standard Oil Development Co.)—Olefin—dihydronaphthalene copolymers.

U.S. 2,545,689 (Shell Development Co.)—Polymers from allylic alcohol monoethers of trihydric alcohols.

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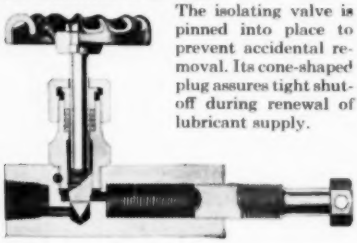

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VALVE PRODUCTS

Processing Patents

U.S. 2,545,716 (Universal Oil Products Co.)—Sulfonamide resins.
U.S. 2,545,811 (Sun Oil Co.)—Plasticized polyvinyl resin.
U.S. 2,545,977 (Standard Oil Development Co.)—Flame resistant rubber compositions containing chlorwax and carbonate.
U.S. 2,546,018 (Shell Development Co.)—Glutaraldehydes from dihydro-pyrans.
U.S. 2,546,019 (Shell Development Co.)—1,5 Pentanediols.
U.S. 2,546,020 (Standard Oil Development Co.)—Multiolefinmonoolefin resin.
U.S. 2,546,220 (Phillips Petroleum Co.)—Emulsion polymerization with diazo thioether—ferricyanide catalyst.
U.S. 2,546,244 (Phillips Petroleum Co.)—Incremental addition of alkaline material in emulsion polymerization.
U.S. 2,546,499 (Universal Oil Products Co.)—Synthesis of coumaranes.
U.S. 2,546,631 (Shell Development Co.)—Color stabilization of halogen-containing polymers.
U.S. 2,546,946 (Socony-Vacuum Oil Co.)—Modified phenol-formaldehyde resins.

Refining

U.S. 2,543,838 (Standard Oil Development Co.)—Oxygen removal from absorption oils.
U.S. 2,543,953 (Socony-Vacuum Oil Co.)—Making sour naphtha doctor sweet with di-sec butyl catechol plus caustic.
U.S. 2,544,214 (Union Oil Co. of Calif.)—Apparatus for gas separation by adsorption.
U.S. 2,544,307 (Standard Oil Development Co.)—Removing oil from filter cakes.
U.S. 2,544,308 (Cities Service Oil Co.)—Removing carbonyl impurities.
U.S. 2,544,317 (Standard Oil Development Co.)—Removing oxygenated compounds from synthetic naphtha.
U.S. 2,545,067 (Union Oil Co. of Calif.)—Adsorption process for separating gaseous mixtures.
U.S. 2,545,199 (Shell Development Co.)—Removal of peroxides from hydrocarbons.
U.S. 2,545,806 (Sun Oil Co.)—Deashing petroleum residua with glycerin.
U.S. 2,545,850 (Union Oil Co. of Calif.)—Adsorption of gaseous components.
U.S. 2,545,954 (Standard Oil Development Co.)—Bauxite treating of synthesis oils.
U.S. 2,546,125 (Anglo-Iranian Oil Co.)—Extracting vanadium compounds from fuel oils for gas turbine engines.
U.S. 2,546,345 (The Texas Co.)—Dethiolizing hydrocarbons with caustic and glycol ether with alkanolamine.
U.S. 2,546,349 (The Texas Co.)—Distillation of gasoline containing hydrocarbon fractions.
U.S. 2,546,916 (Socony-Vacuum Oil Co.)—Refining residual asphaltic lubricants with HF.

Catalysts

U.S. 2,543,863 (Standard Oil Development Co.)—Fluidized catalyst regeneration.
U.S. 2,544,869 (Universal Oil Products Co.)—Silica-magnesia catalyst.
U.S. 2,546,031 (Phillips Petroleum Co.)—Regeneration of aluminachromia catalyst.

Hydrocarbon Synthesis

U.S. 2,543,791 (The Texas Co.)—Engine generation of synthesis gas.
U.S. 2,543,795 (Standard Oil Development Co.)—Liquid and gaseous fuels by synthesis from coal.
U.S. 2,543,974 (M. W. Kellogg Co.)—Hydrogenation of carbon monoxide.
U.S. 2,544,574 (Stanolind Oil & Gas Co.)—Synthesis catalyst regeneration.
U.S. 2,546,017 (Standard Oil Development Co.)—Hydrogenation of carbon monoxide.

Conversions

U.S. 2,543,884 (Standard Oil Development Co.)—Cracking and coking heavy hydrocarbons.
U.S. 2,544,350 (Sinclair Refining Co.)—Catalytic conversion of hydrocarbons.
U.S. 2,545,041 (M. W. Kellogg Co.)—Temperature control in regeneration of contact agents.
U.S. 2,545,162 (Standard Oil Development Co.)—Detecting incipient afterburning during regeneration.
U.S. 2,545,165 (Standard Oil Development Co.)—Gas-solid contacting apparatus and means for stripping solid particles.
U.S. 2,545,384 (Phillips Petroleum Co.)—Insulation of catalyst chambers.
U.S. 2,545,671 (M. W. Kellogg Co.)—Alkylation of aromatic hydrocarbons.
U.S. 2,546,042 (Phillips Petroleum Co.)—Catalytic conversion of hydrocarbons.
U.S. 2,546,044 (Phillips Petroleum Co.)—Catalyst chamber.

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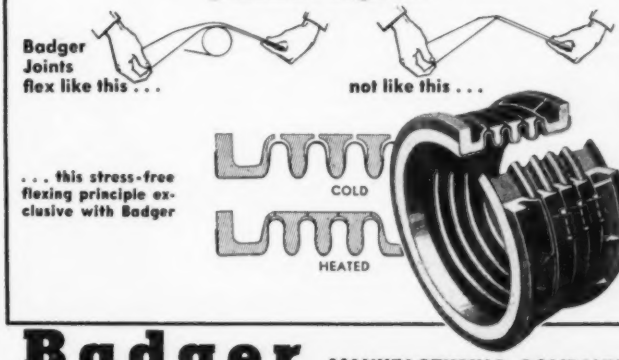

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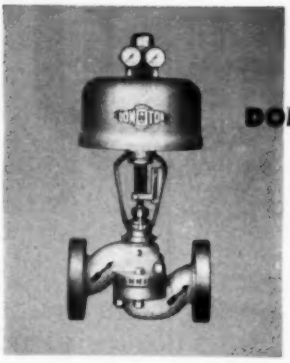

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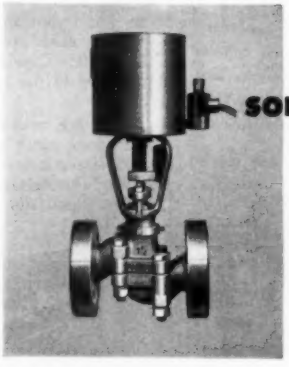

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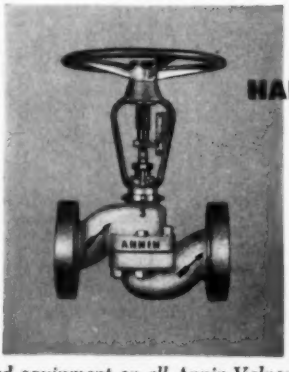

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Processing Patents

U.S. 2,546,234 (Sinclair Refining Co.)—Vapor phase cracking with diazo thioether-ferricyanide catalyst.
U.S. 2,546,235 (Sinclair Refining Co.)—Cracking with ammonium fluoride catalyst.
U.S. 2,546,272 (Sinclair Refining Co.)—Cracking with ammonium iodide catalyst.
U.S. 2,546,570 (Phillips Petroleum Co.)—Fluidized bed reactor.
U.S. 2,546,625 (Socony-Vacuum Oil Co.)—Hydrocarbon conversion with granular catalyst.
U.S. 2,546,634 (Socony-Vacuum Oil Co.)—Contacting gases with particle-form solid material.
U.S. 2,546,930 (M. W. Kellogg Co.)—Polymerization in presence of double fluoride catalyst.

Specialties

U.S. 2,543,871 (Standard Oil Development Co.)—Determining petroleum sulfonate as re-emulsifying agent for w/o emulsions.
U.S. 2,543,885 (Union Oil Co. of Calif.)—Water-soluble petroleum sulfonates.
U.S. 2,545,176 (Standard Oil Development Co.)—Fungicidal compositions comprising N,N'-bis (4-nitrosophenyl) piperazine.
U.S. 2,545,186 (Shell Development Co.)—Non-aqueous insecticidal emulsions containing esters of phosphorous acids.
U.S. 2,545,963 (Standard Oil Development Co.)—Improving flow properties of asphalt with vinyl polymer.
U.S. 2,545,983 (Standard Oil Development Co.)—Fire foam applicator.
U.S. 2,546,328 (Shell Development Co.)—Carnauba wax substitute.

Lubricants

U.S. 2,543,995 (Standard Oil Co.—Ind.)—Stabilizing copper-contaminated oils.
U.S. 2,544,375 (Monsanto Chemical Co.)—Lubricating oil containing polymer of tetradecyl vinyl ether.
U.S. 2,544,376 (Monsanto Chemical Co.)—Lubricating oil containing polymer of oleyl methacrylate.
U.S. 2,545,113 (Gulf Oil Corp.)—Alkali metal addition agents for mineral oil lubricants.
U.S. 2,545,114 (Gulf Oil Corp.)—Stabilizer for greases.
U.S. 2,545,126 (Phillips Petroleum Co.)—Fatty acids and grease therefrom.
U.S. 2,545,158 (Standard Oil Development Co.) Oxidation resisting hydrocarbon products containing P-S compound.
U.S. 2,545,190 (Shell Development Co.)—Alkali base lubricating greases.
U.S. 2,545,875 (Phillips Petroleum Co.)—Sulfurized lubricant.
U.S. 2,546,552 (Standard Oil Co.—Indiana)—Lubricant containing potassium-neutralized P_2S_5 products, etc.
U.S. 2,546,941 (Shell Development Co.)—Lube oil containing trichloromethyl di (thiaethyl) methane as E.P. agent.

Fuels

U.S. 2,546,180 (Wiczer) — Motor fuel by passing olefins and methane over aluminum chloride and Ni or Pt at 400-800° F and 60-100 atm.

Miscellaneous

U.S. 2,544,697 (Standard Oil Development Co.)—Blast furnace operation using fluidized bed.
U.S. 2,544,843 (Universal Oil Products Co.)—Treatment of solid hydrocarbonaceous material.
U.S. 2,544,912 (The Texas Co.)—Shale distillation with fluidized residue treatment.
U.S. 2,545,179 (Standard Oil Co.—Indiana)—Submarine marker with sonic signal generators.
U.S. 2,545,682 (Universal Oil Products Co.)—Exhaust gas silencer and pressure reducer with plural valved outlets.
U.S. 2,545,701 (Universal Oil Products Co.)—Compensated pipe expansion joint.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

The best fire-fighting foam is Air Foam!

FREE AIR FOAM REFERENCE CATALOG

Air Foam is more effective, less expensive than chemical foam

Pyrene* Air Foam is the finest fire protection yet devised for oil fire hazards. It extinguishes fast, prevents flash-backs and re-ignition, is *compact* and extremely flexible. Pyrene* Air Foam is available in America's most complete line of portable, fixed, and mobile units, for any size hazard. In most instances, they can be operated by one man! Installation and upkeep costs are almost always lower than those for chemical foam. And foam compound costs less.

If your firm must cope with the danger of oil fire hazards, you owe it to yourself to study the Pyrene reference catalog, and have the information in it available at your fingertips. Send for your copy today—without any obligation, of course.

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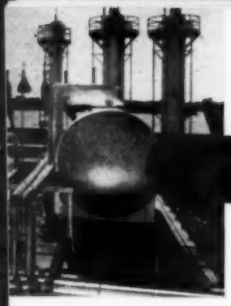


EQUIPMENT PATENTS

Brief Reviews of New Inventions in Equipment

Adjustable Displacement Pump Improves Precision of Injection

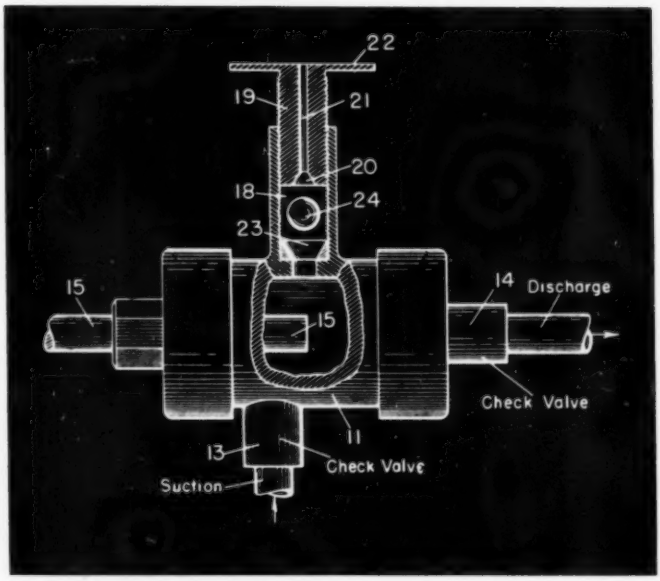


FIG. 1—ACCURATE INJECTION of small quantities of chemicals is provided in this adjustable pump (U. S. 2,543,828)

CLOSELY controlled injection of small quantities of chemical compounds into process streams can be obtained by means of an adjustable displacement pump said to overcome the inaccuracies and time lags encountered in conventional injection pumps due to lost motion in the regulating mechanical linkages.

The principle of the device is illustrated in the sketch in Fig. 1. Injection fluid is drawn into the apparatus through inlet 13 and discharged through outlet 14. On the discharge stroke of piston 15, liquid will rise in chamber 18, carrying with it the sphere 24 before any fluid overcomes the resistance of the check valve in conduit 14. As sphere 24 rises with the liquid, any air in chamber 18 is forced out through passage 21, until the sphere seats itself at 20. This permits pressure build-up, causing the check valve in outlet 14 to open and allow liquid to be injected into the system connected to outlet 14.

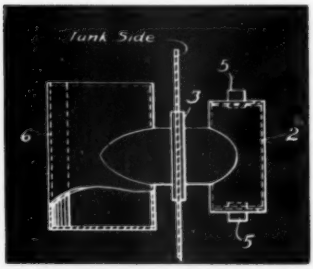
On the suction stroke, the sphere drops into the lower seat 23, sealing chamber 18 from cylinder 11, at the same time opening check valve at inlet 13 to draw in liquid from the source. Manipulation of adjustment wheel 22 alters the size of chamber 18 and the length of travel of the sphere 24. A larger chamber 18 reduces the amount of liquid actually injected via outlet 14, while a smaller chamber conversely increases the quantity of that liquid. Thus, the device gives a variable control of the amount of liquid injected between the limits of zero and full piston displacement.

A preferred modification of the invention which overcomes the difficulties of obtaining complete sealing at seats 20 and 23 employs an impervious diaphragm in the center of what would be chamber 18. An adjustable plug, using a regulating arrangement similar to threaded plug 19, provides for changing the volume of the space above this diaphragm. An exit passageway similar to 21 is provided from the space below the diaphragm. Otherwise, the modified form operates on the same basic principle.

U. S. 2,543,828, issued March 6, 1951, to Stephen S. Brown, assignor, by mesne assignments, to Standard Oil Development Co.

Inexpensive Foam Applicator Built from Standard Fittings

A SIMPLE fire-foam applicator for permanent installation on oil storage tanks may be constructed out of standard pipe fittings. It is said to provide proper mixing of foam



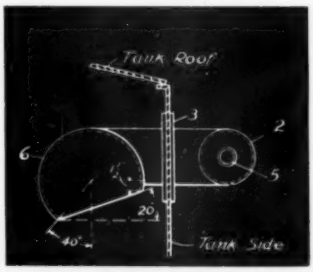


FIG. 2—SIMPLIFIED FIRE FOAM APPLICATOR for oil storage tanks (U. S. 2,545,983)

BS&B QUALITY

You can turn your fabricating problems over to BS&B with full confidence. Every step of production must be approved by BS&B *Quality Control!*

Long ago, BS&B learned the necessity and value of Quality Control in producing precision oilfield, refinery and chemical equipment. Because the standard items in the BS&B line utilize practically all industrial metals including alloys and precious metals, a wide variety of instruments and tools are in constant use. BS&B technicians have designed and built special testing equipment where standard types proved inadequate.

Material quality, welding quality...even paints and plastics quality... are under constant scrutiny. *That means your most exacting specifications will be carried out as ordered.*

Put BS&B's 58 years of experience on your production team! Fully equipped, modern plants...skilled craftsmen...large engineering staff ...convenient location...and always-alert Quality Control! Write today for complete information concerning custom fabrication of pressure vessels and large weldments.

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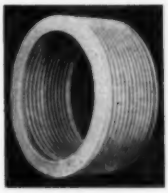
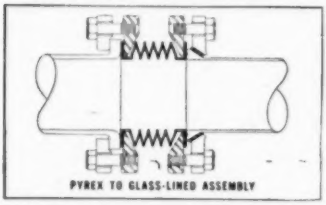
TEFLON
EXPANSION JOINTS

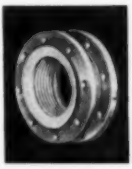


- *Tough*
- *Heat-Resistant*
- *Absolutely Chemical-Proof*

If your problem is thermal expansion, vibration, misalignment or any other condition demanding a flexible, chemical-proof piping section, then USG's Chemiseal Teflon Expansion Joints can save you money. They're tough, long-lasting and completely impervious to chemical attack.



Fabricated by a special USG process, Chemiseal Expansion Joints accommodate axial contraction and expansion or any reasonable amount of misalignment or vibration without danger of cracking or bursting. They're designed for 25 lb. pressure and are serviceable in a wide temperature range (−150° F. to 400° F.). Remember—Teflon is so inert chemically that it *cannot be attacked by nor contaminate* any known chemical used commercially.



Chemiseal Teflon Expansion Joints are available for any type of equipment and for a wide variety of operating conditions. Joints are normally supplied with suitable integrally-gasketed flanges drilled to 150 lb. A.S.M.E. standard. Exact requirements must be specified, so we'll be glad to send you Catalog No. 212 containing complete information.

Teflon Products Division

UNITED STATES GASKET COMPANY

644 N. 10th Street

Camden, New Jersey

chemicals without extensive internal baffling and without large pressure drop and blackflow. The unit also overcomes the problems associated with improper foam laydown and the resultant breakdown of the foam blanket.

As shown in the two views in Fig. 2, the applicator is located near the tank roof. Outside the tank wall is a mixing chamber 2, consisting of a Tee connected to and held on the tank by flange 3. This Tee may be made from standard weight, lap welded steel pipe. For an applicator with a designed delivery rate of 500 gpm. of fire foam solutions, it may consist of 8-in. diameter pipe. Cross-arm length is not extremely critical, but a dimension of 18 in. has been found satisfactory. Cross-arm ends are capped with steel plate, centered in which are standard 2½-in. couplings 5 for the introduction of foam solutions.

The simple baffle 6 inside the tank consists of another Tee cross-arm with a cutaway segment at the bottom as illustrated. Dimensions preferred here are 16-in. diameter pipe about 2 ft. long, with steel plates at each end. The critical point is the positioning of the opening segment.

U. S. 2,545,983, issued March 20, 1951, to Edwin R. Wilkinson and Thomas H. Richardson, assignors to Standard Oil Development Co.

Patents Issued in March

The following classified listing covers patents issued during the month of March believed to be of interest or value to petroleum processing or handling operations:

Catalytic Reactors

2,545,165 (Standard Oil Development Co.)—Gas-solid contacting apparatus, including means for stripping solid particles.
2,545,384 (Phillips Petroleum Co.)—Insulation of catalyst chambers.
2,545,686 (Universal Oil Products Co.)—Internally lined and insulated chamber.
2,546,042 (Phillips Petroleum Co.)—Apparatus and process for the catalytic conversion of hydrocarbons.
2,546,044 (Phillips Petroleum Co.)—Catalyst chamber construction.
2,546,570 (Phillips Petroleum Co.)—Fluidized bed catalytic reactor.
2,546,625 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for hydrocarbon conversion by moving bed catalytic means.
2,546,634 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for contacting gases with particle form solid material.

Processing, general

2,543,743 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for high temperature thermal conversion of hydrocarbon gases.
2,544,214 & 2,545,850 (Union Oil Co. of California)—Apparatus for gas separation by adsorption on a moving bed of solid granular adsorbent material.
2,544,575 & 6 (Phillips Petroleum Co.)—Pebble feeders.
2,545,144 (Standard Oil Development Co.)—Apparatus and process for the production of high molecular weight polymers
2,545,651 (Sun Oil Co.)—Fractionating tower bubble cap tray.
2,545,682 (Universal Oil Products Co.)—Exhaust gas silencer and pressure reducer with plural valved outlets.
2,545,691 (Universal Oil Products Co.) — Fractionating tray.
2,545,938 (Allis-Chalmers Mfg. Co.)—Solvent extraction apparatus.
2,546,246 (Prat-Daniel Corp.)—Apparatus for centrifugally separating suspended particles from gases.
2,546,349 (The Texas Co.)—Apparatus for distillation of gasoline containing hydrocarbon fractions.

Instruments

2,543,825 (Phillips Petroleum Co.)—X-ray diffraction apparatus.
2,543,859 (Standard Oil Development Co.)—System and method for analyzing substance by mass spectrometry.
2,544,012 (The Liquidometer Corp.)—Indicating and control device for, among others, the purpose of measuring and totalizing contents of tanks of different shapes.
2,544,665 (Rockwell Mfg. Co.)—Gas meter of the bellows type.
2,544,717 (University of Minnesota)—Mass spectrometer.
2,544,718 (University of Minnesota)—Ion collector for mass spectrometers.
2,544,734 (Phillips Petroleum Co.)—Automatic filler for cylinders of liquefied petroleum gas.
2,544,919 (Bailey Meter Co.)—Printing totalizer for stylus recording meters.
2,544,948 (Joseph Morton Caldwell)—Variable orifice flow control device.
2,545,309 (Transducer Corp.)—Weld testing instrument.
2,545,732 (James W. Hamilton)—Combustion control device.
2,546,273 (Ralph Poole, London, England)—Apparatus for detecting explosive gases.
2,546,715 (General Electric Co.)—Gas analyzer detecting device.

Valves and Fittings

2,543,846 (Clayton Mfg. Co.)—Quick-operating pressure relief valve.
2,543,528 (Standard Oil Development Co.)—Valve device for controlling the injection of fluids.
2,543,996 (Petrolite Corp. Ltd.)—Fluid distribution nozzle.
2,544,090 (Duriron Co.)—Plug valve.
2,544,108 & 9 (Brockway Co.)—Flare type connectors for ductile pipe and tubing.
2,545,701 (Universal Oil Products Co.)—Compensated pipe expansion joint.
2,546,673 (E. D. Mattix and C. W. Stokes)—Flow control valve with variable Venturi.

Tools

2,545,355 (A. G. Hanson)—Slidable jaw wrench provided with cam actuated locking means.
2,543,824 (B. M. and B. Beesley)—Slidable inner jaw wrench having a pivoted rack catch.
2,544,224 (Phillips Petroleum Co.)—Circular slide rule for solving equations relating to equilibrium between two phases in multiple component systems.
2,544,633 (W. G. Le Count Tool Works)—Expansible mandrel.
2,544,801 (Air Reduction Co., Inc.)—Welding gun.
2,546,287 (Albert V. Zelgert)—Wrench having pivoted outer jaw provided with guide slot for handle-jaw extension.
2,546,756 (Griscom-Russell Co.) — Tube expander.

Pumps and Compressors

2,545,238 (H-P-M Development Corp.)—Radial vane pump.
2,545,422 (Byron Jackson Co.)—Motor pump, vertical type, centrifugal.
2,545,604 (Robbins & Myers Co., Inc.)—Positive displacement pump with a helical rotor.
2,546,302 (Cooper-Bessemer Corp.) — Flexible diaphragm pump.

Tanks & Vessels

2,544,828 (Preload Enterprises, Inc.)—Leakproof construction using concrete for pipes, tanks, and the like.
2,546,572 & 3 (John H. Wiggins)—Liquid-sealed lifter roof for fluid storage tanks.

Miscellaneous

2,543,963 (A. P. Smith Mfg. Co.)—Gasketed joint for pipe.
2,545,926 (Hudson Engrg. Corp.)—Air and liquid cooling tower.
2,545,983 (Standard Oil Development Co.)—Fire foam applicator for installing in oil storage tanks.

DU PONT REG. U.S. PAT. OFF.

PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT REG. U.S. PAT. OFF.

May ★ One of a Series of Interest to the Petroleum Industry ★ 1951

Petroleum Laboratory Finds Copper Present in Commercial Gasoline Samples

Du Pont's Petroleum Laboratory at Deepwater, N. J. recently checked thirty-three samples of commercial gasoline for copper content and found the element present in seventeen of the samples. The table below shows the geographical distribution of these samples together with a range of copper content observed:

	No. of Samples	*No. with Copper*	*Range of Copper Content in p.p.m.*
Phila.	7	2	.06 to .12
Tulsa	5	2	.06 to .12
Chicago	8	3	.05 to .21
Los Angeles	6	4	.05 to .13
Houston	7	6	.02 to .09

The analyses were conducted by the colorimetric method which will detect copper whether it is deactivated or not. As a result, the data do not indicate how many of the contaminated samples contained deactivator.

Automotive Technologist Specializes in Analysis of Engine Operational Problems

IVER T. ROSENLUND, who came with Du Pont in 1947, is the company's automotive engine specialist for the analysis of operational problems encountered in automotive equipment including farm tractors and heavy-duty trucking units. He was formerly Manager of the Du Pont Road Test Laboratory which operates a fleet of test trucks out of El Monte, California. Mr. Rosenlund is available to automotive equipment manufacturers, fleet operators and others who wish to make use of his extensive experience.

Mr. Rosenlund graduated from the University of Michigan in 1937, with a Bachelor of Science degree in aeronautical engineering, majoring in engine design. He spent the first few years of his career in aircraft engine testing and the development of automatic machine tools for the manufacture of aircraft engine parts. He has been actively engaged in problems of combustion and lubrication of engines since 1939 when he became a research engineer on engine testing for the development of petroleum products for the Texas Company in its research laboratory at Beacon, New York.

Between 1942 and 1947, Mr. Rosenlund was fuel and lubrication engineer for Allison Division of General Motors and later joined the Packard Motor Car Company in the jet-engine division at Toledo, Ohio, as project engineer on combustion chamber design and development.

Du Pont Truck Fleet Develops Valuable Heavy-Duty Road Test Data

What would you think of a fleet owner who gave his drivers instructions to take a load of gravel on a 208 mile jaunt and to return without delivering the cargo? Yet this is what happens regularly to each of six identical semi-trailer combinations operating out of the Du Pont road test laboratory at El Monte, California.

Shown are two of the fleet of six trucks used by Du Pont to make commercial, heavy-duty road octane tests. Each truck grosses 26,000 pounds on every trip. The terrain at this point appears rugged.

In evaluating the performance of experimental antiknock fluids prior to release for consumer use, laboratory testing is not enough. That is why Du Pont operates a six vehicle, heavy-duty, commercial test fleet under severe overload conditions on the hill and desert highways around Los Angeles.

A typical test might cover as much as 35,000 miles. As would be expected, much information is developed. Included would be information on octane requirements; valve life; cylinder bore wear and piston ring wear; fuel and oil consumption; and data on sludge and varnish deposits.

Here are some of the interesting characteristics of the fleet which travels without destination, delivers no load, yet brings back highly significant information.

The six tractor-trailer combinations are identical in every way, including their 235 cubic inch valve-in-head engines. The body of each trailer is partitioned to prevent shifting of the gravel which is used to weight the vehicles. This precaution is necessary to maintain a constant load on the tires which often are experimental tires being service-tested by the Rubber Chemicals Division of Du Pont.

The six vehicles always travel in convoy. They gross 26,000 pounds each. This weight corresponds to a sixty per cent overload for the tractor rating. With this loading, full throttle operation is required over most of the

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

Refinery Calls in Du Pont Automotive Specialist to Solve Annoying Problem

Fleet Customer Blamed Trouble on Refiner's Fuel

An Eastern District customer of Du Pont had complaints of engine sludging and heavy deposits on intake ports and valves from a fairly large fleet using its products. As is often the case, the refiner's products were blamed.

The refiner asked one of Du Pont's automotive specialists to investigate. He contacted the fleet owner, accompanied by refinery representatives. Several days were consumed in discussing the problems and in examining the fleet units and their operational patterns.

Both passenger cars and trucks were involved. Daily mileages were low, ranging from 40 to 100 miles. There was little prolonged heavy-duty work. Much of the operation was under conditions where engines were never completely warmed up in the course of a day.

Lengthy round-table discussions ended in the conclusion that most of the vehicles were subjected to unfavorable operating conditions such as prolonged idling and low output operation, with short hauls, frequent shutdown, and subnormal operating temperatures. These operating conditions, plus too infrequent oil change periods, were considered to be sufficient to cause the crank case sludging and intake valve troubles reported. Remedial recommendations were made and carried out to a satisfactory solution of the problem.

From the above it will be seen that Du Pont can contribute both knowledge and experience to the solution of a problem in the field. In such matters Du Pont will cooperate wherever it is feasible to do so.

Du Pont Offers *New Blending Calculator*

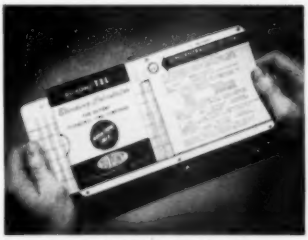
(AVIATION MIX)

A slide calculator for easy determination of the number of pounds of Du Pont Tetraethyl Lead Compound – Aviation Mix required for a given quantity of gasoline, is available through Du Pont Petroleum Chemicals Division District Offices.

The calculator is designed as a time-saver for blenders, chemists or others engaged in blending tetraethyl lead compound with gasoline.

Convenient in size, 9" x 4½", the calculator easily fits into a desk drawer or a coat pocket. With it, one can calculate the pounds of TEL Compound required to treat a given number of barrels of gasoline to produce concentrations from 0.1 to 4.6 cc. of TEL per gallon.

The calculator is quickly set in one operation.



This extremely handy Du Pont TEL Compound (Aviation Mix) Blending Calculator can be supplied by the nearest Du Pont Petroleum Chemicals Division District Office.

LITERATURE AVAILABLE

The following is a partial listing of free Du Pont bulletins, reports, booklets and aids available to you. Address requests to your nearest Du Pont Petroleum Chemicals Division District Office.

Du Pont Services to the Petroleum Industry . . . . . Serial A-663

Exhaust Valve Rotation – covers the use of mechanical devices to improve valve life . . . . . Serial A-656a Pet.

Du Pont Gasoline Antioxidants Nos. 5, 6 and 22 – describing their use and application for improving gasoline storage stability . . . . . Serial A-513

The Effect of Hydrocarbon Structure on the Road Antiknock Performance of Motor Fuels . . . . . Serial A-505

Tank Talk – a 52-page pocket-sized booklet written for the men who actually enter and clean gasoline storage tanks . . . Serial A-1134

CONTINUED *Truck Fleet*

test route. The trucks are operated for sixteen hours per day.

The drivers and positions of the trucks are rotated daily to overcome variations which might be caused by differences in driver techniques. Drivers try to treat all trucks alike even in such minor details as braking, shifting and accelerating.

The route presents a normal intercity truck route winding through the foothills and mountains near Los Angeles. There are steady upgrades at full throttle, rolling downgrades requiring closed throttle positions and considerable stop-and-go driving in cities. The 208 mile course requires an eight hour shift per circuit.

Engines are operated at three-quarter to full throttle approximately seventy percent of the time. Average speed is thirty-seven miles per hour – maximum is fifty-five.

Since findings from the operation of this fleet are too detailed to be presented here, the principal purpose of this résumé is to suggest that there is considerable value in fleet work of the type outlined as a reproducible method for investigating differences resulting from fuel variables.

It is believed that experimental compounds which show promise in convoy operated tests can be released for further proof testing in commercial operations with considerable assurance of satisfactory performance. The tests also show that uniformly good performance can be obtained by paying close attention to maintenance techniques.

For more complete data on the findings address your nearest Du Pont Petroleum Chemicals District Office.

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NEWS OF SUPPLIERS

Manufacturers
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National Research Appoints Kiddoo

Mr. Kiddoo

Gordon Kiddoo, most recently director of research and development for Continental Carbon Co., has been appointed assistant director of the petrochemical research department of National Research Corp., Cambridge, Mass. He will be in charge of the engineering economic aspects of a joint program National Research is undertaking with Electric Bond and Share Co. and the United Gas Corp.

Following graduation in 1942 from Cornell in chemical engineering, Mr. Kiddoo was employed by the Chicago Corp. in oil and gas production and cycling plant operations near Bishop, Texas. From 1944 to 1945 he was with Hydrocarbon Research, Inc., at the Olean, N. Y., laboratories in pilot plant development of fuels and chemicals synthesis from natural gas. He was associated with The Texas Co. from 1945 to 1949 in research and development work, and since 1949 has been at Amarillo, Texas, with Continental Carbon.

MIT Holds Instrumentation Course

The theory and applications of feedback control systems (servomechanisms), and the broad concept of "system engineering," will be the subject of a special course at Massachusetts Institute of Technology, from August 20 to 31. The 10-day course will include morning lectures and afternoon demonstrations and laboratory work in the electrical engineering department's student laboratories.

Three members of the faculty will assist Prof. Donald P. Campbell in presenting the course: Prof. Gordon S. Brown, director of the MIT Servomechanisms Labortory; and Paul E. Smith, Jr., and Leonard A. Gould, instructors in the feedback control laboratory.

The course is intended for engineers with a background in the problems of industrial engineering and production management. It will be open to those with no previous acquaintance with servomechanisms, although a familiarity with the engineering problems to be discussed will be helpful.

Further information may be obtained from Prof. Walter H. Gale, director of the MIT Summer Session, Room 3-107, MIT, Cambridge 39, Mass.

New Instrument Firm in Philadelphia

The formation of a new manufacturer's agency in Philadelphia has been announced by William A. Diament, formerly vice president and sales manager of Fischer & Porter Co. The organization is named "Devicengineering", and is located at 1701 Walnut St., Phila. 3, Penna.

The firm will represent manufacturers devoted largely to custom electrical, hydraulic, and instrument devices for industrial and aircraft applications. The selling program is said to be the first step in a pattern of sales management activities planned for the future.

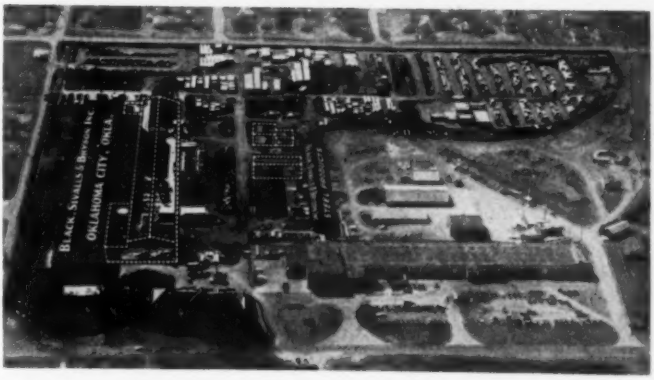
Prior to his association with Fischer & Porter from 1941 to 1950, Mr. Diament had served in sales and

Black, Sivalls & Bryson Expand Facilities

A major expansion of plant facilities and modernization of equipment, costing $1,200,000, has been announced by Black, Sivalls & Bryson, Inc., for both Oklahoma City and Kansas City. Over two-thirds of the expenditures will be for additions to the present plant in Oklahoma City. The oil and gas equipment division, including engineering and sales staffs will be moved to that location from the general offices in Kansas City.

The program, to be completed within the year, will increase output at Oklahoma City 50% and is expected to raise personnel 25%. A new high bay, 80 x 600 ft., and a low bay, 40 x 240 feet, will be constructed, adding 57,000 sq. ft. of manufacturing area. Considerable new equipment will be installed, including a bending roll for cold steel plates up to 3 in. thick.

Ralph W. Nichols, who recently rejoined BS&B as sales manager of the oil and gas equipment division, will establish headquarters at the expanded Oklahoma City location. Floyd C. Myers, manager of branch operations, also will transfer from Kansas City to the new plant in accordance with the policy of concentrating the oil, gas, and refining business at that point.



Dotted lines indicate new construction at Black, Sivalls & Bryson's plant

USE AIR *instead of liquids* FOR COOLING

While the principle of air-cooling in heat exchangers is not new, its adaptation on a large scale in industry is being recognized more and more. Air as a coolant can be used under certain conditions with greater economy and higher efficiency than is practical with liquids.

The advantages of air-cooling are readily recognized in cases where ample water supply is not available, where such water may cause scale or premature corrosion, or where treatment required for the water would prove expensive. Many more advantages will suggest themselves.

One of the major components in all air-cooled heat exchangers is, of course, the tubing. And the tubing that deserves serious consideration in such applications naturally is Wolverine Trufin* (the integral finned tube)—and specifically the bi-metal Trufin. This tube has aluminum fins and copper liner, which latter can be supplied in most copper base alloy specified to accommodate the contacting fluids. Obviously, such factors as corrosion, pressure, etc. determine the type of liner and composition of the tube that would prove most efficient.

Since the fins of Trufin are integral with the outer tube itself, they stand upright and remain in a fixed position. Moreover, because there is a good mechanical bond between the two metals, very little loss of efficiency is experienced regardless of the type of liner.

There is much specialized experience here at Wolverine upon which you are invited to draw for help in solving problems involving heat exchangers.

Shown here are two views of an air-cooled heat exchanger installed in the south by Hudson Engineering Co. Nearly a quarter-million square feet of surface area is represented in the installation of Wolverine Trufin—the integral finned tube. This bi-metal Trufin was specifically developed for this air-cooling application and is the direct result of the study of conditions found there by Wolverine's Customer Engineering Service.

*Reg. U. S. Pat. Off.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
Manufacturers of seamless, non-ferrous tubing
1425 CENTRAL AVENUE • DETROIT 9, MICH.

Wolverine Condenser Tubes stocked by Butler Industries, Inc., 355 South Fourth Street, Beaumont, Texas • Tel: Beaumont 5-2351.

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Company, London, Ontario

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
Sales Offices in Principal Cities

Export Department 13 E. 40th St., New York 16, N. Y.

engineering capacities with H. Belfield Co., Henry Vogt Machine Co., General Electric, and E. G. Budd Mfg. Co.

Blom Becomes V.P. at Byron Jackson

Mr. Blom

Carl Blom, associated with Byron Jackson Co., Los Angeles, since 1924, has been elected a vice president. He had been chief engineer of the pump division since 1940. A graduate in hydraulic engineering in 1922 from the Trondheim Institute of Technology, Trondheim Norway, Mr. Blom came to Byron Jackson as a pump design engineer following one year as an instructor at the Institute.

He has designed a number of large and important pumping projects during his career with the company, the most recent of which was the 27 line pumps now moving oil 1067 miles from the Persian Gulf to the Mediterranean Sea.

Moore, Danco Establish New Firm

Air-powered recorder chart drives will be a new product of Air Clock, Inc., Hungtington Station, New York, a new company established by Danco Instruments, Inc. and Moore Products Co. of Philadelphia.

The air clock uses regular instrument air supply as a power source and is the same size essentially as conventional electric chart drives. It is said to be readily mounted inside standard circular chart recorder or recording controller cases. It is expected to provide the answer to the need for all-pneumatic equipment in hazardous locations.

Charles D. Corey, president of Danco, has also been named president of the new company.

Foxboro Adds Assembly Building

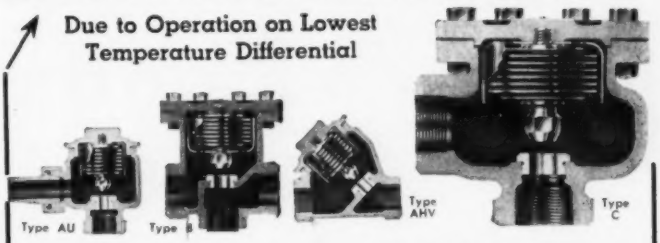
A new one-story building now nearing completion will add 50,000 sq. ft., or an increase of almost 25%, to the working area in the main plant of The Foxboro Co., in Foxboro, Mass. It is located so as to be a connection on the same floor level between the present factory buildings and a new 50 x 200 ft. warehouse, recently completed.

The new structure will be used principally for the final assembling and testing of recorders and controllers, thus permitting expansion of other departments in the older buildings for production of electronic and

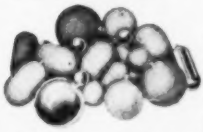
Nicholson Steam Traps

STOP WATERLOG LOSS

Due to Operation on Lowest Temperature Differential



Repeated comparative tests by large trap users show that Nicholson traps operate on lowest temperature differential: 5° to 15°, depending on trap size and steam pressure. Production of cooking kettles, for example, has been increased as much as 30% because fast action of Nicholson traps keeps equipment full of live steam. They are specified for all apparatus where back-up of condensate causes corrosion or damage to thin gauges. 5 types for every application; size ¼" to 2"; pressure to 225 lbs.



HIGH - PRESSURE FLOATS — Stainless, monel, steel or plated steel. Welded. In all sizes and shapes; for operating mechanisms and as tanks or vessels. 2-day delivery. BULLETIN 650.

BULLETIN 450 or Refinery Catalog

W. H. NICHOLSON & CO., 215 Oregon St., Wilkes-Barre, Pa.

Depend on

AUTO-LITE

FOR TEMPERATURE INDICATION

Auto-Lite Thermometers are designed to give you the broadest selection for your needs: Priced low and precision-made for accuracy, these instruments point the way to temperature savings and help to prevent spoilage. Write for catalog showing the many styles and types of Auto-Lite Thermometers that are available.

FOR APPLICATIONS IN NATURAL GASOLINE & CYCLING PLANTS, PUMPING STATIONS, REFINERIES, ETC.

Illustrated, at top: Model G Indicating Thermometer, flush mounting type with capillary tubing for remote reading. Priced from $18. At bottom: Model V Thermometer (vapor pressure type). Rigid stem for direct mounting. Priced from $10.25.

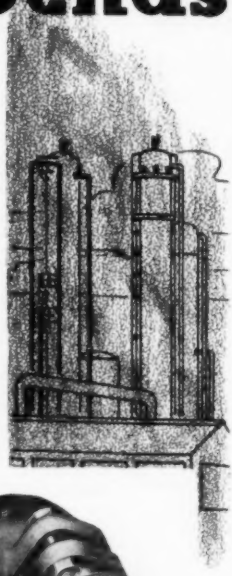
THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION, DEPT. O-8
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

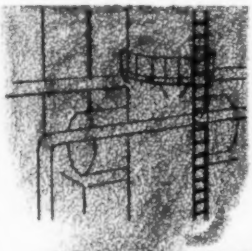
INDICATING & RECORDING THERMOMETERS

(To obtain more data on advertised products see page 548)

OHIO
Return Bends

TYPE 2000





TYPE 2500

SECTIONAL FITTINGS

Type 2000 is a sectional return bend with separate U-bend and two-piece yokes or housings. No rolling jigs are required as patented locking device holds tube in rigid alignment while rolling tubes and provides flexibility when in operation.

Type 2500 is also a sectional return bend with separate U-bend and two-piece yoke. It is used for condenser installations and top rows of vertical furnaces.

THE OHIO STEEL FOUNDRY CO.
LIMA, OHIO — Plants at Lima and Springfield, Ohio

District offices in:

Chicago	Detroit	Pittsburgh
Cincinnati	Houston	San Francisco
Cleveland	New York	St. Louis
Dallas	Philadelphia	Tulsa

(To obtain more data on advertised products see page 548)

electric instruments. In addition to this new assembly building, a new training school building is beng erected across the street from the main offices and factory.

Nordstrom Strengthens Sales Staff

Rockwell Mfg. Co., Pittsburgh, has announced a number of changes in personnel in the Nordstrom Valves sales forces. E. E. Matheson will move to the Oakland, Calif., plant, where he will act as liaison between production, engineering, and sales. With the company since 1928, he has been general sales manager since 1945. Prior to 1928, Mr. Matheson was an engineer with Shell Oil Co. and later chief engineer of the Victory Mfg. Co.

Mr. Matheson

Mr. Gottwald

H. Gottwald, also with the firm since 1928, becomes general sales manager for Nordstrom valves. Starting as a sales engineer in the New York district, Mr. Gottwald was later appointed assistant vice president of the Rockwell International Corp. Since his move to the home office, he has been assistant sales manager of Nordstrom valves and assistant vice president of Rockwell's meter and valve division.

R. R. Bush will be oil field products sales manager, and O. W. Barnett will be sales manager of warehouse and jobber sales. Both men joined the company in 1934, beginning with field work in the Oklahoma areas.

American Cy Builds in L. A.

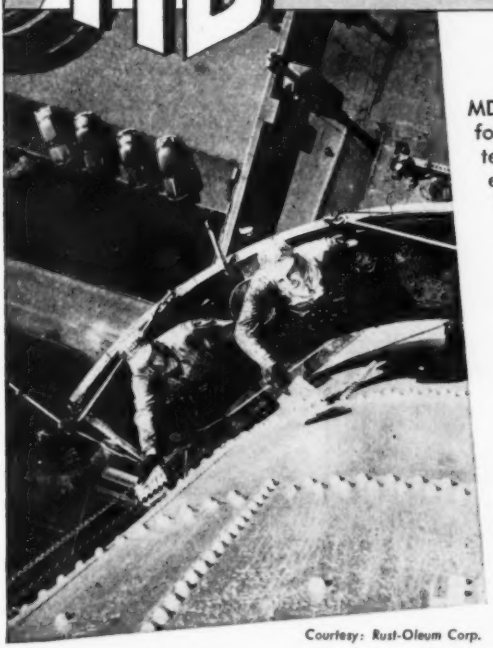
Construction will soon be under way on a 64,000 sq. ft., one-story building for American Cyanamid Co. in Los Angeles' central manufacturing district. The structure will contain 44,000 sq. ft. of warehouse space, with the balance being given over to air-conditioned offices. It will serve to consolidate activities at a number of locations in the area.

Among company units which will use the new facilities are the Calco Chemical Division's pigment department and bulk pharmaceutical department; the Industrial Chemicals

Now..

MD 565W ALUMINUM PASTE...

...meets Federal Specification TT-A-468a, Type II, Class B



Courtesy: Rust-Oleum Corp.

An ideal pigment for industrial and maintenance paints

MD 565W is an all-purpose Aluminum pigment for the formulation of Aluminum Paint required for the maintenance and maximum protection of petroleum equipment. Also meets A.S.T.M. Spec. D 962-49, Type II, Class A.

MD 565W provides these 3 big advantages:

- ★ **LOWER EVAPORATION LOSS**—because it reflects heat to a higher degree than standard paste pigments.
- ★ **LESS FREQUENT PAINTING**—Due to its greater degree of whiteness, color change is at a much lower rate.
- ★ **IMPROVED APPEARANCE** — because it produces a whiter, brighter finish with minimum of highlighting and spotty glare.

The non-glare characteristics of MD 565W are particularly advantageous in the painting of large surfaces, such as tanks. It eliminates highlighting and overlapping—leaves no "checkerboard" area patterns. As a result, of these characteristics which are unique in this pigment alone, MD 565W has experienced an increasing demand in the petroleum industry.

In your aluminum painting, specify that MD 565W be used in the formulation of the ready-mixed Aluminum Paint you purchase. In these paints which you formulate, specify MD 565W in your pigment purchases.

SEND FOR— your copy of Bulletin 504

Complete line of MD ALUMINUM PIGMENTS meets all the requirements of a wide range of standardized and specialized Aluminum Paint applications.

METALS DISINTEGRATING COMPANY, INC.

General Offices: Elizabeth B, New Jersey
Sales Offices: Chicago, Ill., Cleveland, Ohio

Plants: Elizabeth, N. J. • Manchester, N. H. • Berkeley, Calif. • Emeryville, Calif.

1269 MD POWDERS Since 1916

ALUMINUM PASTES
ALUMINUM POWDERS
GOLD BRONZE POWDERS

Division; Plastics and Resins Division; and Lederle Laboratories Division's branch and regional sales office. Cyanamid's west coast executive offices, now located at Azusa, will also be in the new building. Completion is scheduled for Sept. 1.

Tank Manufacturers Organize

The Oilfield Tank Manufacturer's Association, organized recently in a meeting at the Mayo Hotel, Tulsa, has established a headquarters office in the Tri-State Insurance Bldg., Tulsa. E. H. Zachariae has been appointed Secretary and is the managing officer of the Association.

Officers and members of the executive committee for the ensuing year are: president, Kenneth W. Lineberry (president of Black, Sivalls & Bryson, Inc., Kansas City, Mo.); vice president, A Sidney Knowles (president of Parkersburg Rig and Reel Co., Parkersburg, W. Va.); treasurer, Sam P. Wallace (president of Maloney-Crawford Tank & Mfg. Co., Tulsa); committee members, I. W. Lovelady (president of Sivalls Tanks, Inc., Odessa, Texas), and Cecil G. Wells vice president of National Tank Co., Tulsa).

Midwest Research Adds Oil Consultant

Dr. Frank C. Fowler, formerly on the University of Oklahoma faculty, has joined the staff of Midwest Research Institute, Kansas City, Mo., as a petroleum consultant. He will conduct investigations in petroleum and allied fields for Midwest, the activity having been initiated as a result of numerous industrial requests for assistance in this field.

Dr. Fowler attended Illinois and Michigan Universities, and was awarded his Ph. D. from the latter in 1943. From 1943 to 1946 he was senior process engineer in the chemical products department of Phillips Petroleum Co., Bartlesville, at which time he joined Okla. U.

Proportioneers Buys Synchro-Master

Proportioneers, Providence, R. I., has acquired Synchro-Master Co., formerly of Seneca Falls, N. Y., and will operate the business as its Synchro-Master Division with sales and production facilities located in Providence. The standard Synchro-Master unit for internal combustion engines will continue as a product, and new designs are contemplated for use in the firm's automatic proportioning and blending systems.

Personnel Changes

Roots-Connersville Blower Corp.—E. P. Roudebush, previously assistant to the vice president in charge of manufacturing, has been promoted to works manager, in charge of all production activities. D. A. Johann, manager of the Chicago district office, has been made sales manager, in charge of all sales and advertising activities.

General Controls Co.—Fred H. Angier, manager of the Baltimore factory branch office since joining this Oakland, Calif., company in 1949, has been made district manager for both Philadelphia and Baltimore. He will be located at the Philadelphia office, 1238 Spring Garden St. J. B. Crandley, a Philadelphia sales engineer, has been moved over to succeed Mr. Angier at Baltimore.

Metal Goods Corp.—R. E. Grote, Jr., has been elected vice president and director of this St. Louis company.

The Hays Corp.—Orval M. Riggs has been appointed to the position of

Something new

...a SEPARATE DIVISION for the CHEMICAL and PETROLEUM INDUSTRIES

The creation of a separate CHEMICAL-PETROLEUM DIVISION for these two vastly important industries is our recognition of the great progress taking place in the Chemical-Petroleum Field and of the continuous increase in volume of business to National Airoil Burner Company from that Field.

For almost 40 years National Airoil Burner Company has, step by step, kept pace with developments in the Chemical-Petroleum Industries. Now, we take added confidence and pride in knowing that we will be even better able to serve these industries.

We know you will be interested in the full particulars we can give regarding your oil-gas-sludge combustion requirements.

NATIONAL AIROIL BURNER CO., INC.

MAIN OFFICE & FACTORY: 1297 EAST SEDGLEY AVENUE PHILADELPHIA 34, PA.

SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD HOUSTON 6, TEXAS

(To obtain more data on advertised products see page 548)

manager, application engineering. He had been chief project engineer in the sales department and has been associated with Hays at Michigan City, Ind., since 1937.

Johns-Manville Corp.—C. A. de Vyver, who joined the firm 22 years ago as a research assistant in the Manville, N. J., laboratories, has been appointed manager for insulations, and will headquarter in the main offices in New York City.

Pacific Pumps, Inc.—W. E. Brown has been made sales engineer for Los Angeles district, suceeding J. W. McCormick who was transferred recently to New York.

Westinghouse Electric Corp.—Mark W. Cresap, Jr., has joined the firm as a vice president and assistant to President Gwilym A. Price. He is a co-founder of the New York and Chicago management consultant company of Cresap, McCormick and Paget.

Branches, Distributors

Owens-Illinois Glass Co. has appointed the **Luse-Stevenson Co.** as a distributor-applicator for Kaylo Heat Insulation in the Chicago area.

Burgess-Manning Co. has opened engineering and sales facilities at 1203 Dragon St., Dallas, to serve the petroleum and chemical industries. Over-all charge of Dallas activities is in the hands of R. L. Leadbetter, vice president of the concern. S. G. Paddock is manager of sales and A. P. Gallagher is assistant engineer.

Expansion, Transition

Burrell Corp. has moved its offices and laboratories to a new five-story building at 2223 Fifth Ave., Pittsburgh 19, Penna. The firm was located previously at 1942 Fifth Ave.

Robert G. Millar, previously vice president and general manager of **Tracerlab, Inc.**, of Boston, has been elected president of the **Kelley-Koett Mfg. Co.** of Cincinnati, Ohio, and Covington, Ky. Tracerlab recently purchased a majority interest in Kelley-Koett. Sidney S. Minault, who has been production manager for Tracerlab, moved up to Mr. Millar's post, and William A. Kerr, Tracerlab's general sales manager, has been appointed vice president of the company.

Pennsylvania Salt Mfg. Co. has formed a new sales department, the industrial chemicals dept., combining the former heavy chemicals and special chemicals departments. It will be headed by Albert H. Clem, previously assistant to the vice president in charge of sales.

with **RUST-OLEUM**

Rust is less spectacular than *insurable* types of oxidation. But it probably costs the oil industry many times the amount lost through fast, headline-making conflagrations.

To protect your tanks, pumps, derricks, refining equipment, buildings, roofs, fences—every rustable metal—against the relentless destructive action of rust—to keep every possible pound of new steel for the defense program—*adopt rust control with RUST-OLEUM as an important part of your maintenance program.*

RUST-OLEUM stops rust. It can be applied *even* over rusted surfaces. It is not necessary to remove all the rust. Just use sharp scraper and wire brush to remove loose rust and rust scale.

RUST-OLEUM can be obtained promptly from Industrial Distributors' stocks in principal cities of the United States and Canada. Write on your company's letterhead for complete catalog and nearest source of supply.

Available in many **COLORS** aluminum and white

RUST-OLEUM CORPORATION
2476 Oakton Street, Evanston, Illinois

(To obtain more data on advertised products see page 548)

BOOK REVIEWS

New Corrosion Book Will Be Help to Petroleum Engineers

Materials of Construction for Chemical Process Industries, by James A. Lee; 6 x 9 in., vii + 468 pages, stiff cloth binding, indexed, illustrated, $6.50. (1950) McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y.

This is an excellent book. Although it deals with all phases of chemical manufacture, it should be of real help to process, design, and corrosion engineers in the petroleum processing field. The title, *Materials of Construction for Chemical Process Industries*, should almost have included the word *corrosion*, because corrosion is really the central theme of the work.

The book represents a good, readily-available reference on and a unique approach to the proper materials needed to combat corrosion. It presents this information based on actual operating experience and case history data rather than laboratory information. It considers and discusses materials as they have been used and proved by practical operating experience, indicating what material has done the best job in combatting corrosion from over 300 specific chemical products.

There is no table of contents as such. Each chemical product or combination of chemical products is treated as a separate "chapter." Individual chemicals are arranged in alphabetical order. In addition, an index helps the reader find information on specific chemicals. Each chapter starts with a brief introduction and then comprises three sections on its production, handling, and packaging. A large number of chemicals used in petroleum processing are included. Information on recommended and commercially proved materials of construction is given as indicated in the three sections. Although few trade names are given in the main text section of the book, a helpful table has been included at the back of the book giving chemical compositions, brief descriptions, and manufacturers' names. This covers all metallic and non-metallic materials.

Pictorial flow diagrams of specific chemical processes, where used, have been arranged with a simple code numbering system to indicate the type of material used at various points in the process. A welcome change in the method of handling literature references (to this reviewer at least) has been to put the complete reference directly in the text as a parenthetical statement. This seems far superior to the more conventional method of using numbers and then listing the bibliographical references at the end of the chapter or in the appendix.

The author, James A. Lee, is Southwestern editor of McGraw-Hill Publications, and formerly managing editor of *Chemical Engineering* and *"Chem & Met."*

Liquid Extraction Text Gives Helpful Design Information

Liquid Extraction, by R. E. Treybal; 6 x 9 in., vii + 422 pages, indexed, illustrated, stiff cloth binding, $7.50. McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.

Although relatively new as a unit operation, liquid extraction is gradually assuming a place of high importance in chemical processing, especially the processing of organics and petroleum hydrocarbons. It was some time in the 1930's that commercial installations began to appear in appreciable numbers.

Unfortunately research on the subject has been limited, and design data especially meager, up to now. *Liquid Extraction*, another in the McGraw-Hill Chemical Engineering Series, should fill the need quite handily for this kind of engineering information. A list of the chapter headings reveals the detailed help that is provided in this new book:

Liquid equilibria, prediction of distribution, choice of solvent, diffusion and mass transfer, methods of calculation for various types of contact, equipment for stagewise and for continuous countercurrent contact, and liquid-extraction processes.

The book has been excellently illustrated with many good flow diagrams, drawings of equipment, tables, and charts. The author, Robert E. Treybal, is professor of chemical engineering, New York University.

Oil Man Writes Helpful Book On Metalworking Lubricants

Metalworking Lubricants, Their Selection, Application, and Maintenance, by E. L. H. Bastian; 6 x 9 in., vii + 357 pages, stiff cloth binding, indexed, illustrated, $6.00. McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.

There's an old chestnut about the man who came into a restaurant and asked to see the manager and was told, "He's out to lunch." This reviewer once worked in a plant manufacturing roof coatings, and the roof always leaked in the place.

So it would seem not at all unreasonable to assume that maintenance men in an oil refinery don't necessarily know all there is about the lubrication of equipment and tools. This new book, *Metalworking Lubricants*, is therefore an excellent text for engineers in petroleum plants who are concerned with preventive maintenance on machinery, machine tools, etc.

Written by an oil man, it covers all important metalworking operations, providing numerous recommendation charts, tables, and practical operating ideas as obtained from plant engineers, foremen, and the like. The main emphasis is on those lubricants for actual metalworking processes. However, there is also coverage of machine lubricants, such as bearing and gear oils and greases, and their application to machine tools, mills, and other similar equipment.

The author, Mr. Bastian, is a staff engineer, Shell Oil Co., N. Y.

Government Publications

Preparation Characteristics of Some Coals Available for the Synthetic Liquid Fuels Industry, Bulletin 495, Bureau of Mines, by Thomas Fraser, William L. Crentz, and Orrin T. Barrett; 8 x 10¼ in., vi + 132 pages, heavy paper cover, illustrated, 50c.

Carbonizing Properties: Pocahontas No. 6, Davy Sewell, and Fire Creek Coals from West Virginia and upper and lower Kittanning and upper and lower Freeport Coals from Pennsylvania, Bulletin 496, Bureau of Mines, by J. D. Davis, D. A. Reynolds, R. E. Brewer, D. E. Wolfson, B. W. Naugle, and G. W. Birge; 8 x 10½ in., vi + 42 pages, heavy paper cover, illustrated, 30c.

Order copies of the above two booklets from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

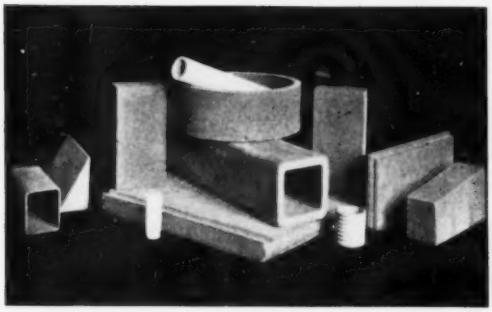
Process Development in the Hydrocarbon Synthesis to 1941 (in Japan), Bureau of Mines Information Circular 7593, February, 1951; 8 x 10½ in., 41 pages plus illustrations, heavy paper cover.

Performance of a Pebble Heater Type Steam Superheater, Bureau of Mines Report of Investigations 4781, March, 1951, by H. R. Batchelder and H. A. Ingols; 8 x 10½ in., eight pages plus illustrations, heavy paper cover.

Investigation of a Photoelectric Device for the Determination of Low Concentrations of Dust, Bureau of Mines Report of Investigations 4782, March, 1951; 8 x 10½ in., six pages plus illustrations, heavy paper cover.

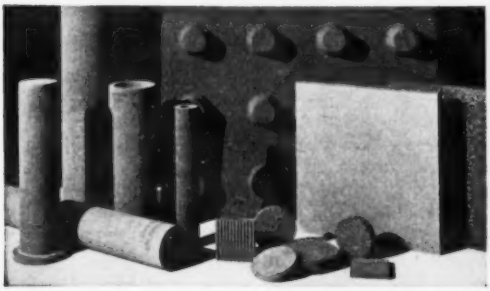
Order copies of the above three free booklets from U. S. Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

Chemical Stability
Contributes to Wider Usage of Fused Alumina



REFRACTORY SHAPES, made of Norton Alundum* mixtures containing 86% to 99.3% fused alumina, resist oxidation in reducing atmospheres at temperatures up to 3450° F. Also highly resistant to chemical attack and mechanical erosion. Write for Bulletin 803.

CATALYST SUPPORTS, made of Norton Alundum mixtures containing 77% to 89% alumina, are highly refractory, chemically inert and extremely durable. Controlled porosity provides wide range of permeabilities and surface areas. Write for experimental samples.



POROUS PLATES AND TUBES made of Norton Alundum grain fired to at least cone 12, are unaffected by acid, neutral and slightly alkaline liquors. They combine uniform permeability with great strength. Write for Bulletin 140.

LABORATORY WARE, made of highly refractory Norton Alundum mixtures containing at least 85% fused alumina (up to 99% in special mixtures), is not attacked by any organic solvent. Write for Bulletin 793.

Investigate! Maybe Norton Alundum shapes can improve your commercial or laboratory processes. The experience of Norton, pioneers in controlling the chemical and physical variables of fused alumina, is at your disposal. Contact your nearby Norton representative or write direct.

NORTON COMPANY, 594 NEW BOND ST., WORCESTER 6, MASS.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

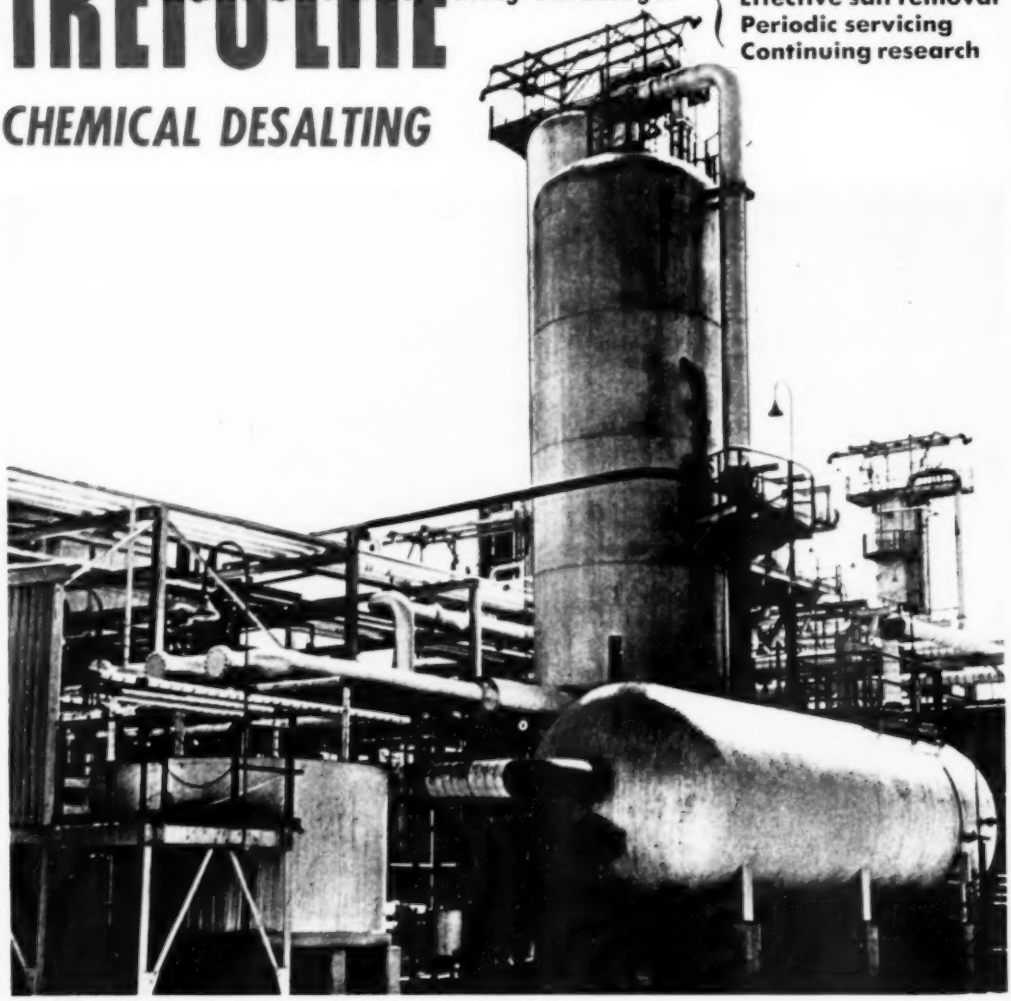
(To obtain more data on advertised products see page 548)

TRET-O-LITE

CHEMICAL DESALTING

assures these money-saving advantages

- Low installation costs
- Low operating costs
- Effective salt removal
- Periodic servicing
- Continuing research



HIGH EFFICIENCY

LOW COST

In many of America's leading refineries Tretolite desalting is delivering salt removals as high as 90 to 95%. The low water requirement seldom exceeds 5 to 8% of the total volume of the crude charge. Tretolite desalters now in use range in capacity from 2,000 to 50,000 barrels per day per plant, since Tretolite desalting is adaptable to either large or small refining operations. Periodic checking by Tretolite desalting engineers insures that your Tretolite desalting process stays at top operating efficiency.

The recognized economy of Tretolite desalting is due to the high flexibility of the process. This process flexibility often permits the use of existing refinery equipment as part of the desalting installation, obviously holding installation costs at a minimum. This low installation cost, plus the low water, heat and chemical requirements, helps to hold Tretolite desalting cost per barrel at a minimum.

TRETOLITE COMPANY *Chemicals for the Petroleum Industry*

ST. LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

DESALTING • DEHYDRATING • WATER DE-OILING • CORROSION INHIBITION • SCALE PREVENTION

TD 51-1

(To obtain more data on advertised products see page 548)

Third World Petroleum Congress

Many Papers on Processes, Products, Equipment Scheduled for Meeting this Month at The Hague

A MAJOR portion of the technical papers scheduled for presentation at the Third World Petroleum Congress, May 28-June 6, The Hague, Netherlands, will be of interest to petroleum processing men.

Four of the 10 sectional meetings will have direct bearing on refinery operations, those on physical operations in oil processing, oil processes involving chemical conversions, production of chemicals from petroleum, and construction of equipment. In addition two more will be of general interest, those on measurement and control, and on utilization of oil products. Many American engineers and scientists are among the speakers. Details of some of the papers, as announced recently by Congress officials, follow:

Physical Operations

A review of the present status of the Hypersorption process for the continuous fractionation of petroleum gases, by Clyde Berg, Union Oil Co. of California.

Comparison of the four main solvent extraction processes in commercial use (sulfur dioxide, furfural, phenol, Duosol), by E. J. Dawson, Shell Refining and Marketing Co., Stanlow, England.

The use of furfural as a selective solvent for the extraction of middle boiling point distillates, especially catalytic cycle gas oils, W. P. Gee et al., The Texas Co.

Extraction of sulfur compounds from synthetic mixtures and high sulfur petroleum stocks by means of hydrogen fluoride, A. P. Lien et al., Standard Oil Co. (Indiana).

A new type of continuous countercurrent extractor (rotating disc contactor), with some applications in the petroleum and chemical industries, G. H. Reman, Royal Dutch Shell Laboratories, Amsterdam, Netherlands.

Chemical Conversions

Two papers will describe the conversion of light olefins into high octane gasolines by catalytic polymerization. Universal Oil Products Co. will present a survey of selective and non-selective polymerization carried out under a variety of operating conditions and applying the UOP solid phosphorus catalyst. California Research Corp. have developed a process in which the catalyst consists of a film of liquid phosphoric acid supported on quartz. It is said that the advantages of this catalyst are low cost, ease of regeneration, high mechanical strength, ready adaptability to various feed stocks, and simple reactor design.

Standard Oil Development Co. have improved the hydroforming process by applying the fluid technique. A paper will show that in this way the process can be carried out under isothermal conditions and that thermal pre-cracking can be avoided. The yields are considerably improved, now more nearly approaching those of the Platforming process for equivalent octane levels. It is stated that capital and operating costs are considerably lower for fluid hydroforming than for the convention fixed bed catalyst processes.

The Institut du Petrole, France, have also studied the hydroforming process in the presence of a fluidized catalyst, aiming at the production of a highly aromatic gasoline to be used in premium aviation fuels. Pilot plant work and the manufacture of blends with isopentane, iso-octane, and catalytically cracked gasoline meeting French specifications are described.

Socony-Vacuum Oil Co. will discuss the application of catalytic cracking to various refinery situations and present typical yield data on the TCC process. The company will also announce the new Thermofor Catalytic Reforming process, which is expected to be available for commercial installations in 1951.

Imperial Oil Ltd. will give a paper on operating variables and reactions in Suspensoid cracking, describing the results of pilot plant tests. The effects of temperature, pressure, reaction time, and feedstock boiling range on product quality and distribution are included.

Production of Chemicals

The rapid increase in the production of synthetic detergents from petroleum during the last decade is reflected in the facts that a special sub-section of the Congress will be devoted to this subject. Five papers, all from the United States will be presented. One will give a review of typical methods used in the manufacture of the most important detergents of the anionic, kationic, and nonionic types. Another will describe the chemical, physical, and performance properties of detergents of the alkyl-aryl-sulfonate type.

Equipment, Materials, etc

The sessions on equipment, materials, corrosion, etc. will include technical papers on a wide variety of important topics. Among the kinds of equipment to be covered are cooling towers, heat transfer units, centrifugal compressors for propane refrigeration systems, fire protection, mechanical shaft seals, calculation of stresses and influence of high temperatures on pressure vessel flanges, storage tank standardization

OIL MAN'S CALENDAR

MAY

13-16, **American Institute of Chemical Engineers,** Regional Meeting, Hotel Muehlebach, Kansas City, Mo.

14-16, **American Gas Assn.,** operating section, production and chemical conference, Hotel New Yorker, New York City.

23-24, **American Society for Quality Control,** 5th National Convention, Public Auditorium, Cleveland.

28-June 6, **Third World Petroleum Congress,** The Hague, Netherlands.

31-June 1, **Natural Gas & Petroleum Assn. of Canada,** Royal Connaught Hotel, Hamilton, Ontario.

JUNE

2, **California Natural Gasoline Assn.,** June Frolic, Rio Hondo Golf Club, Downey, Calif.

3-8, **Society of Automotive Engineers,** summer meeting, French Lick Springs Hotel, French Lick, Indiana.

7-8, **American Management Assn.,** general management conference, Waldorf-Astoria Hotel, New York City.

11-15, **American Society of Mechanical Engineers,** semi-annual meeting, Royal York Hotel, Toronto, Ontario.

18-22, **American Society for Testing Materials,** 54th Annual Meeting, Atlantic City, N. J.

25-29, **American Institute of Electrical Engineers,** summer general meeting, Royal York Hotel, Toronto, Ontario.

JULY

4-14, **British Instrument Industries Exposition,** National Hall, London.

AUGUST

13-15, **Society of Automotive Engineers,** West Coast meeting, Olympic Hotel, Seattle, Wash.

SEPTEMBER

3-7, **American Chemical Society,** Diamond Jubilee meeting, Hotel Statler, New York City.

9-13, **12th International Congress of Pure and Applied Chemistry,** Hotel Statler, New York City.

10-14, **Instrument Society of America,** Sixth National Conference and Exhibit, Coliseum, Houston, Texas.

12-14, **National Petroleum Assn.,** Hotel Traymore, Atlantic City, N. J.

16-19, **American Institute of Chemical Engineers,** regional meeting, Sheraton Hotel, Rochester, N. Y.

24-28, **American Society of Mechanical Engineers,** petroleum mechanical engineering conference, Tulsa, Okla.

25-28, **American Society of Mechanical Engineers,** fall meeting, Radisson Hotel, Minneapolis, Minn.

OCTOBER

4-5, **California Natural Gasoline Assn.,** 26th annual fall meeting, Ambassador Hotel, Los Angeles.

8-10, **American Oil Chemists' Society,** fall meeting, Edgewater Beach Hotel, Chicago, Ill.

8-12, **National Safety Council,** 39th national congress and exhibition, Hotel Stevens, Chicago.

14-20, **OIL PROGRESS WEEK.**

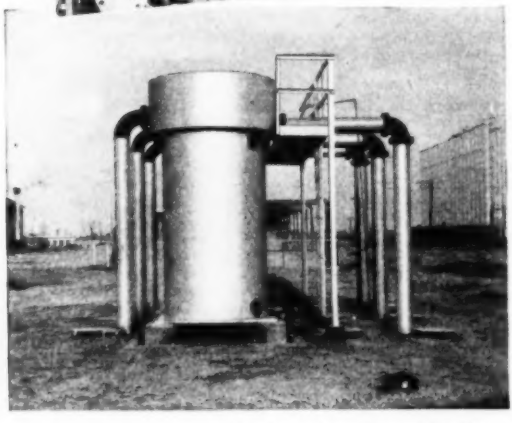
Dirty Water can't "Shut-down"...

Vogt

film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler*

BOTTOM: *Jacket Water Coolers serving engines of 7,500 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Lower Net Draft on Refinery Heating Oil Stocks Than in Preceeding Season

THE upturn in the volume of heating oil stocks (kerosine and distillates) in early April focuses attention on the fact that the net draft on these stocks in the current heating season has been less than in the preceding season by about 10,000,000 bbls. Also the total volume of stocks the current March 31 was larger than on March 31, 1950, by nearly 6,000,000 bbls.

At the start of the current season, uneasiness had been expressed as to the sufficiency of stocks, since demand was estimated at from 15 to 20% higher than the previous year. The manner in which demand for heating oil products has been met reflects the increased volume of crude runs and also the flexibility of refiners in general in turning out kerosine and distillate fuels.

Crude Runs to Stills

Indicated runs from refinery operations the first 3 weeks in April were around 6,200,000 b/d avg., about 4% lower than in March and the lowest rate for 1951 thus far.

Total crude runs for the first quarter of 1951 are a little over 582,000,000 bbls., which is 20% above crude runs for the first quarter of 1950.

In recent months yield of principal products proportionate to crude runs has been a little lower than in the corresponding months the year before. If continued consistently this may be due to the fact that more refinery gases are being produced, in relation to liquid products, the gases being for aviation gasoline and synthetic rubber materials.

Motor Fuel Supply, Demand

Indicated motor fuel supply in April, based on 3 weeks of refinery operations, was at the rate of 2,857,000 b/d, somewhat under that for March. Normal seasonal trend is for motor fuel supply to start to increase in April, or at least hold at March levels. April rate of supply is a little better than 10% higher than in April, 1950.

Indicated motor fuel demand at refineries in April, 3,026,000 b/d avg., was in line with the seasonal swing, and is about 8% higher than actual demand in April, 1950.

Gasoline stocks at refineries started their seasonal decline in April from their peak of 142,433,000 bbls., reached on March 31. The total of 138,890,000 bbls. in stocks on April 21 represents 43 days supply in terms of forecast demand.

Gasoline stocks on March 31, 142,433,000 bbls., compare with 133,766,000 bbls. at the end of March, 1950. The buildup from Sept. 30 to March 31 this year is 36,685,000 bbls., which compares with a buildup of 31,714,000 bbls. in the same period the previous year. In view of the high anticipated civilian demand and the increasing military requirements for motor fuel, the current level of gasoline stocks, even though higher than a year ago, cannot be considered as burdensome on refiners in general.

Heating Oils

Both kerosine and distillate production at refineries continued their normal seasonal decline in April, as indicated by three weeks' operations. Their combined output is an indicated 1,592,000 b/d avg., which is 275,000 b/d avg. (21%) larger than in April, 1950.

Indicated refinery demand for heating oils in April was 1,535,000 b/d avg., about 20% larger than April, 1950, demand, and in line with the general increase in demand over the past several months.

Refinery stocks of heating oils on April 21, 1951, 57,655,000 bbls., represent 50 days supply of demand as forecast by the Bureau of Mines, while stocks on April 30, 1950, were 53 days' supply of actual demand. Since heating oil demand of recent months has been running 8 to 9% larger than forecast demand, present stocks in terms of future days' supply may be actually less than 50 days.

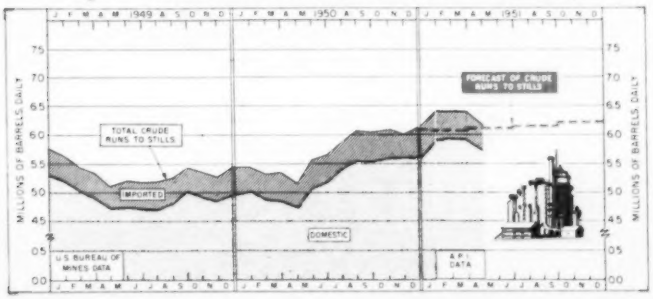
Heating oil stocks at their low point of 56,455,000 bbls. on March 31 compare with 50,778,000 bbls. at the end of March, 1950.

Residual Fuels

Residual fuel output at refineries in April showed a normal seasonal rate of decline. Daily indicated output, 1,253,000 b/d avg., was around 16% higher than in April, 1950. April demand at refineries, 1,680,000 b/d avg., was about 10% larger than in April, 1950.

Residual fuel stocks on April 21, about 36,000,000 bbls., are the lowest on record and represent less than 25 days' supply of coming demand, as compared with 29 days' supply for stocks on April 30, 1950.

Fig. 1—Crude Runs Follow Seasonal Pattern—Drop



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Apr. '51 API*	5,710	451	6,161
Apr. '50 BM	4,732	461	5,193
Change	+978	−10	+968
% Change	20.6	2.2	18.7

* Through April 21.

Total (1000 bbls.)
(Bureau of Mines Data)

3 Mo. '51*	535,204	46,850	582,054
3 Mo. '50	442,506	41,686	484,242
Change	+92,648	+5,164	+97,812
% Change	20.9	8.1	20.2

* March from API data.

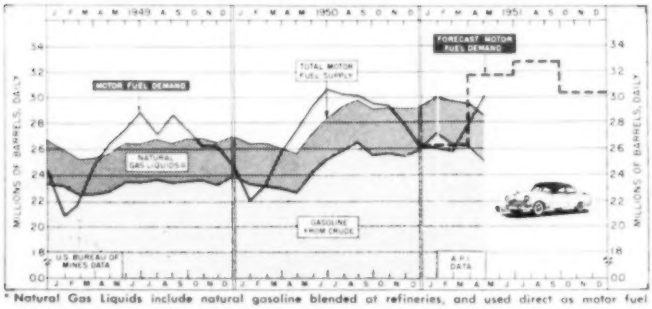
BM Forecast of Runs to Stills, 1951
(1000 bbl. avg., by Quarters)
1st Q., 6,100; 2d Q., 6,130; 3d Q., 6,150; 4th Q., 6,210

Yields on Crude Runs to Stills

	Gasoline	Kerosine	Dist. Fuels	Resid. Fuels
	%	%	%	%
Apr. '51 API*	40.9	6.6	15.9	20.4
Mar. '51 API	40.9	6.1	20.5	21.1
Feb. '51	40.4	6.2	21.7	21.1
Apr. '50 BM	43.6	7.7	18.8	20.1

* Through Apr. 21.

Fig. 2—Motor Fuel Demand Continues Rise



* Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel

Fig. 3—Gasoline Stocks Begin to Drop

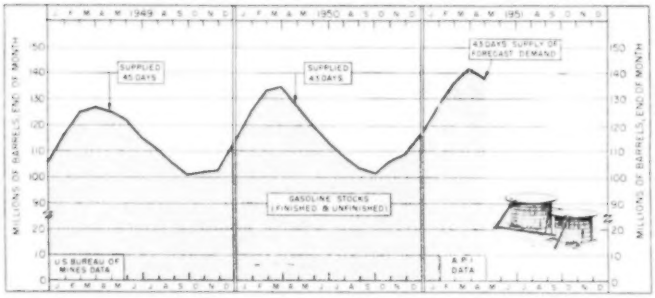

SUPPLIED 45 DAYS
SUPPLIED 45 DAYS
45 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH

Fig. 4—Heating Oil Output Overtakes Demand

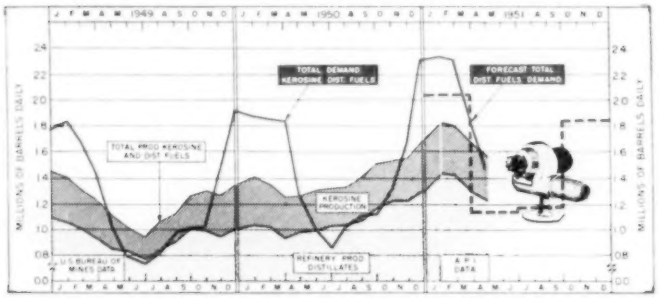
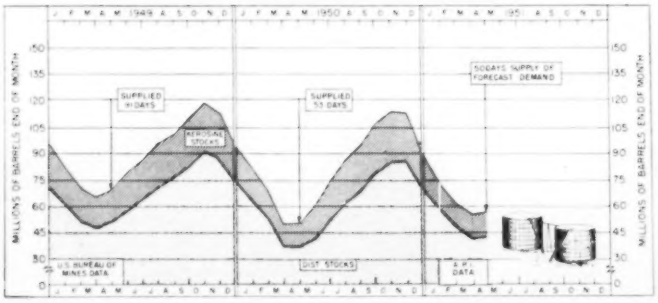

TOTAL DEMAND KEROSINE DIST. FUELS
FORECAST TOTAL DIST. FUELS DEMAND
TOTAL PROD KEROSINE AND DIST. FUELS
KEROSINE PRODUCTION
REFINERY PROD. DISTILLATES
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS DAILY

Fig. 5—Heating Oil Stocks Make Slight Gain



Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Apr. '51 API*	2,514	343	2,857
Apr. '50 BM	2,275	312	2,587
Change	+239	+31	+270
% Change	10.5	10.0	10.4

* Through Apr. 21.

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '51*	239,266	30,409	269,675
4 Mo. '50	208,591	27,819	236,410
Change	+30,675	+2,590	+33,265
% Change	14.7	9.3	14.1

* March from API data.

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Apr. '51 API*	5,095
Apr. '50 BM	2,707
Change	+260
% Change	9.6

* Through Apr. 21.

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '51*	245,602
4 Mo. '50	214,199
Change	+29,403
% Change	13.7

* March from API data.

BM Forecast of Motor Fuel Demand, 1951
(1000 bbl. avg., by Quarters)
1st Q., 2,629; 2nd Q., 3,187; 3rd Q., 3,272; 4th Q., 3,044

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Apr. '51 API*	138,850
Mar. '51 API	142,435
Feb. '51	137,243
Apr. '50 BM	128,057

* On Apr. 21.

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
Apr. '51 API*	370	1,222	1,592
Apr. '50 BM	295	977	1,272
Change	+75	+245	+320
% Change	25.4	25.1	25.1

* Through Apr. 21.

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '51*	36,200	124,508	160,708
4 Mo. '50	30,709	90,288	120,997
Change	+5,491	+34,220	+39,711
% Change	18.2	37.9	32.9

* March from API data.

Heating Oils Demand

Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
Apr. '51 API*	303	1,272	1,575
Apr. '50 BM	282	994	1,276
Change	+21	+278	+299
% Change	7.5	28.0	23.4

* Through Apr. 21.

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '51*	42,267	124,604	166,871
4 Mo. '50	38,841	128,213	167,054
Change	+3,426	−25,809	−22,383
% Change	8.8	20.1	13.4

* March from API data.

BM Forecast of Heating Oils Demand, 1951
(Kerosine and Distillates)
(1000 bbl. avg., by Quarters)
1st Q., 2,930; 2nd Q., 1,145; 3rd Q., 1,180; 4th Q., 1,837

Heating Oil Stocks

(1000 bbls. end of month)

	Kero-sine	Dist. Fuels	TOTAL
Apr. '51 API*	14,698	42,957	57,655
Mar. '51 API	13,285	45,170	58,455
Feb. '51	13,150	47,387	60,537
Apr. '50 BM	13,383	37,530	50,913

* On Apr. 21.

Fig. 6—Residual Demand, Production Fall Sharply

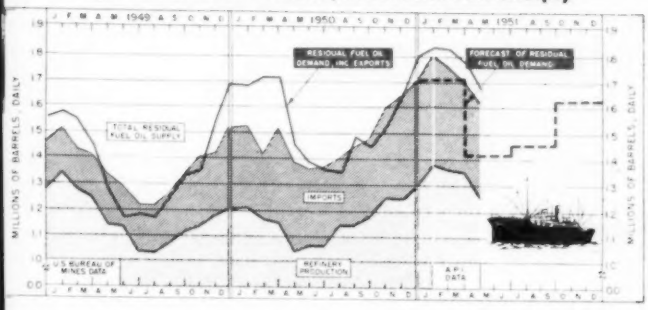
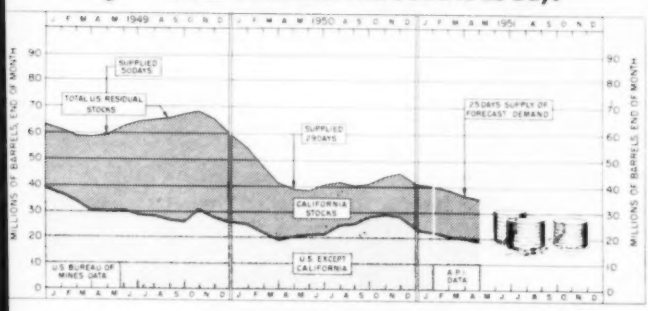


Fig. 7—Stocks of Residual Fuel Down to 25 Days



Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Apr. '51 API*	1,255	361	1,614
Apr. '50 BM	1,041	354	1,395
Change	+212	+7	+219
% Change	20.3	2.0	15.7

* Through Apr. 21.

Total (1000 bbls.)
(Bureau of Mines Data)

1 Mo. '51*	123,069	26,794	149,854
1 Mo. '50	106,077	28,794	134,871
Change	+16,983	+8,000	+24,983
% Change	16.0	27.8	18.5

* March from API data.

Residual Fuels Demand

Daily Average (1000 bbls.)

Apr. '51 API*	1,680
Apr. '50 BM	1,470
Change	+210
% Change	14.3

* Through Apr. 21.

Total Demand (1000 bbls.)

1 Mo. '51*	162,402
1 Mo. '50	154,459
Change	+8,972
% Change	5.8

* March from API data.

BM Forecast of Residual Fuels Demand, 1951
(1000 bbl. avg., by Quarters)
1st Q., 1,722; 2nd Q., 1,437; 3rd Q., 1,467; 4th Q., 1,641.

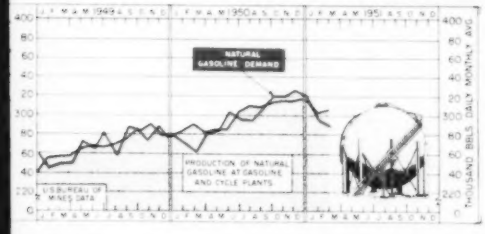
Residual Fuel Stocks

1000 bbls. end of month

	U.S. Except California	Total U.S.
Apr. '51 API*	19,188	35,890
Mar. '51 API	20,162	37,282
Feb. '51	21,430	39,469
Apr. '50 BM	20,039	39,979

* On Apr. 21.

Fig. 8—Production and Demand of Natural Gas Liquids



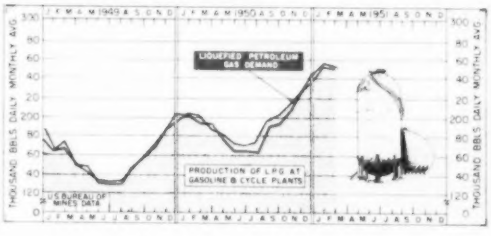
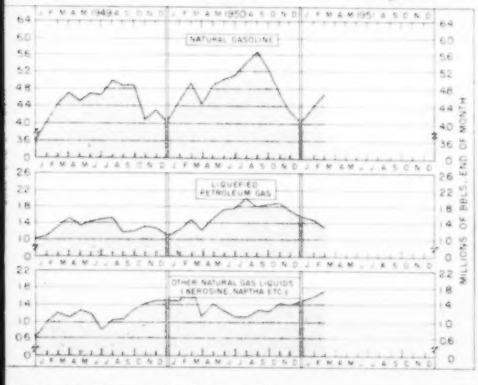


Fig. 9—Stocks of Natural Gas Liquids



Natural Gas Liquids Statistics

Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations.

	Production (1000 bbl./day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 bbl./day avg.) Natural Gasoline	LPG	TOTAL
Feb. '51	507	251	758	292	253	545
Feb. '50	290	203	493	262	195	457
Change	+17	+48	+65	+30	+58	+88
% Change	5.9	23.6	13.2	11.5	29.7	19.3
	Total Production (1000 bbl.)			Total Demand (1000 bbl.)		
2 Mo. '51	18,030	14,897	32,927	17,298	15,077	32,375
2 Mo. '50	16,859	12,028	28,887	15,791	11,777	27,568
Change	+1,171	+2,869	+4,040	+1,507	+3,298	+4,807
% Change	6.9	23.8	13.9	10.2	28.0	17.8

	Stocks, End of Month (1000 bbl.) By Type of Product: Natural Gasoline	LPG	Other Products†	By Location: Refineries	Gasoline Plants	TOTAL
Feb. '51	4,725	1,524	1,783	2,604	5,238	7,842
Jan. '51	4,406	1,445	1,623	2,462	5,012	7,474
Feb. '50	4,964	1,588	1,703	3,966	6,289	8,255

* Demand, including exports but not transfers, is supplied from receipts from outside sources as well as current production and stock changes at gasoline plants. Outside receipts in February totaled 200,000 bbls.

** Does not include LPG produced at refineries which in February totaled 2,828,000 bbls.

† Includes naptha, kerosine, specialty and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

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(A5) BADGER & SONS CO., E. B. 452, 453
(A6) BADGER MFG. CO. 527
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(A8) BYRON JACKSON CO. 476
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(B4) CRAWFORD FITTING CO., THE 560
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(B6) DU PONT DE NEMOURS & CO., INC., E. I. Facing 532, 533
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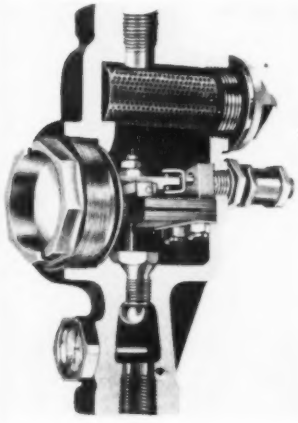
(F3) PROCON, INC. 450
(F4) PYRENE MFG. CO. 529
(F5) ROOTS-CONNERSVILLE BLOWER CORP. 464
(F6) RUST-OLEUM CORP. 539
(F7) SELAS CORP. OF AMERICA 471
(F8) SHERWIN-WILLIAMS CO., THE 520
(F9) SIER-BATH GEAR & PUMP CO. 552
(G1) TAYLOR FORGE & PIPE WORKS 563
(G2) TRETOLITE CO. 542
(G3) UNITED STATES GASKET CO. 532
(E4) UNITED STATES STEEL CORP., OIL WELL SUPPLY CO. 519
(G4) UNIVERSAL OIL PRODUCTS CO. 462, 463
(G5) VOGT MACHINE CO., HENRY 544
(G6) WIEDEKE CO., THE GUSTAV 562
(G7) WOLVERINE TUBE DIV. 534
(G8) WORTHINGTON PUMP & MACHINERY CORP. 484
(G9) WYATT METAL & BOILER WORKS Outside Back Cover

WHAT'S NEW!

Equipment
Materials
Processes
Literature

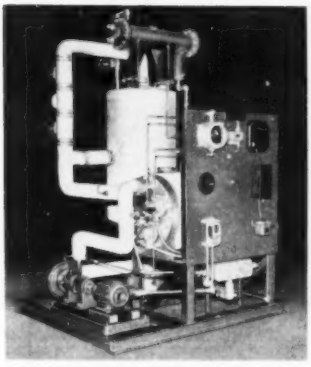
Reviewed by WILLIAM C. UHL, Equipment Editor

Bi-metallic Thermal Element Actuates New "Five-in-One" Steam Trap



Piping simplification is made possible with the new "Velan Universal" steam trap designed for the process industries, in which one compact unit provides the functions of steam trap, air by-pass valve, check valve, strainer, and flow sight glass. Utilizing a bimetallic thermal element to actuate the discharge valve, one trap will serve a wide range of steam pressure and temperature applications because the bimetal operates as a function of the saturated steam curve. Valve opens by steam pressure, closes by thermal action. Desired discharge temperature can be set by an adjustment on the bimetal element. Trap is frostproof when in the vertical, but it can be mounted at any angle. Orifice is ½ or ⅝ in. The ½-in. orifice has the capacity of ordinary 2-in. traps, manufacturer states. Pressure ratings are 0-50 and 50-200 psi. in semi-steel, and 50-350 psi. in cast-steel. Other models are available without strainers, and in alloys for pressures to 650 psi., temperatures to 1000° F. Manufacturer reports a number of traps have been installed in new cracking units at Shell Oil refinery in Montreal. Velan Engrg. Co.

Circle No. **1** *on Reply Card*



Line of Electric Dowtherm Units Has Capacities up to 500,000 Btu./Hr.

Struthers Wells has developed a new standard line of electrically heated Dowtherm heat transfer units. Supplied complete with instruments, piping, insulation, and other accessories, the units are ready for use immediately upon delivery, the manufacturer states. With capacities from 100,000 to 500,000 Btu/hr., the heaters have a temperature range to about 750° F. using Dowtherm as the medium. Other heat transfer agents may be utilized in the equipment. The complete package may be base mounted at the factory or supplied with all essential equipment for the purchaser's mounting. The units include a special heating element designed to eliminate thermal breakdown or coking troubles. Struthers Wells Corp.

Circle No. **2** *on Reply Card*

Large Chamber in Non-Frosting Gage Improves Accuracy with Boiling Fluids

A new non-frosting, large chamber, level gage is particularly suited to gaging low temperature, light, gaseous fluids that tend to boil or surge, because the larger area at the meniscus — approximately 3 in. as against about ½ in. in standard gages — results in less turbulence. They also include the Jerguson patented gage glass extension, which prevents frost from forming over the vision slot. Two models, the series RLF-10 (reflex) and series TLF (transparent), are offered for use in petroleum, chemical, and other process industries for such materials as propane, ethylene, ammonia, freon, etc. When installed, the entire gage may be covered with insulation, leaving only the outer surfaces of the non-frosting window extension exposed. The non-frosting window is a transparent unit extending from the gage glass and projecting beyond the cover bolts, and has no effect on the accuracy of readings. Jerguson Gage & Valve Co.

Circle No. **3** *on Reply Card*

New Non-brittle Protective Coating Is Resistant to Most Corrosive Materials

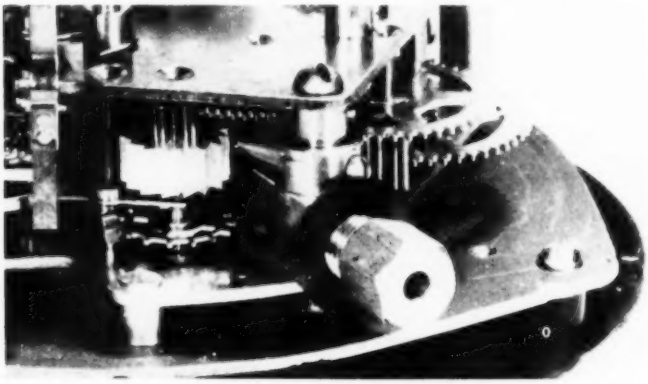
"Alkaloy 550" is a new, non-brittle, protective coating which is resistant to all alkalies, solvents, salts, and most acids. It is available as a high solids content liquid, which is converted at the time of its application to a jet black resilient solid. The material is available in small quantities for experimental purposes and in unlimited amounts with proper priority. Atlas Mineral Products Co.

Circle No. **4** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

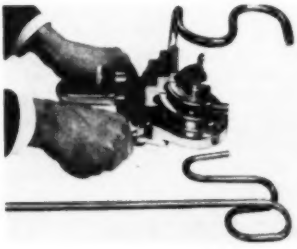
Recorder Installation's Safer with Air-Driven Chart



AIR NOZZLE AND DRIVE WHEEL, foreground, replaces spring in mechanical clock converted to safe air-drive

The "Air Clock" is a new air-operated drive mechanism for recorder chart drives which provides for safe operation of instruments located in hazardous areas. It will also simplify installation on control room panels by eliminating electric conduit. The drive is a standard mechanical clock which uses an air jet for power instead of a spring. Using 15 to 25 psi. air supply, the device meets accepted time-keeping standards of within ±1 for 360 degrees rotation of chart. Air consumption is less than 0.15 scfm. with a 20 psi. supply, according to test results. Clocks can be installed in standard recorder and recording-controller cases. Spacers and adapter plate provide for mounting in practically all standard make cases. Drive shafts are furnished to suit standard chart hubs. Two speeds are available: 24-hour rotation, and 24-hour, 7-day, dual speed rotation. Overall dimensions are $4\frac{1}{8}$ in. diameter by $1\frac{1}{2}$ in. thick. Air Clocks, Inc.

Circle No. 5 on Reply Card



Small, Portable Tube Bender Useful For Instrument Line Installations

Instrument tubing can be bent rapidly with a new light weight, portable tube bender, the Tal Model 1200, which requires no vise or extra fixtures, and is designed similar to large pipe-bending tools in same line. The tool makes bends up to 180° in $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{5}{8}$ in. O.D., K and L copper tubing, brass, Bundy weld, steel, and other light gages. Total weight of the bender is 5 lbs. It is being offered at a price of $38.00, F.O.B. factory at Milwaukee, Wis. Tal Bender, Inc.

Circle No. 6 on Reply Card

Explosion-proof Solenoid Housing May Be Used on Electrical Pilot Valves

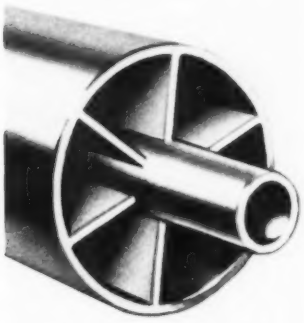
An explosion-proof solenoid housing has been developed for use on Ross electrically operated pilot controlled valves. It can be used wherever fire and explosion hazards exist, is manufactured of cast aluminum to the Underwriters' Laboratory specifications, Class 1, Group D, air break type. Provision is made for standard conduit connection. The cover may be used with $\frac{1}{4}$ to $1\frac{1}{4}$ in. size, pilot-operated, straight-way, three-way, four-way, and four-way five port models for single solenoid operation of Ross base mounted pilot controlled valves. Ross Operating Valve Co.

Circle No. 7 on Reply Card

Worm-and-Gear Operation Is Added To Line of Lubricated Plug Valves

Worm-and gear operated valves have been added to the Homestead-Reiser line of lubricated plug valves. Identified as Fig. 502 GW, the units have the patented "Self-Seald" construction characteristics of this manufacturer's product. Port area is equivalent to 100% of the area of standard pipe. They are cast in semi-steel and made in 8, 10, and 12-in. sizes. The valves will soon be made available also in cast-steel, full-port type to be known as Fig. 562 GW; and in venturi type sizes to 14 in. In the venturi-type these valves will have face-to-face dimensions identical to those of like-sized Series 15 wedge gate valves, and will be designated Fig. 512 GW for semi-steel and Fig. 572 GW for steel. Homestead Valve Mfg. Co.

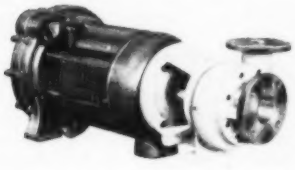
Circle No. 8 on Reply Card



Two-Fluid-Pass Exchanger Tubing Serves Wide Variety of Applications

A new two-fluid-pass heat transfer surface in the form of concentric tubing with radial fins was designed originally for a specific application involving low temperatures and high pressures. However, it has been found adaptable to such other uses as gas liquefaction, condensing, exhaust heat recovery and other requirements involving viscous materials. "CRF Tubing" has been made with six radial fins as shown in the illustration, and in diameters of 1 and $1\frac{3}{8}$ in. Tube geometry can be modified, however, to meet special needs, including variation of inner and outer tube diameters and fin spacing. It can be fabricated of copper, steel, stainless steel, nickel, and other metals in lengths up to 20 ft. Tubing may be equipped with simple Tee-end fittings to provide easy access to both passes, and can be arranged in series parallel banks. The tubing is currently offered only in production-lot quantities, because it is engineered to meet individual applications. Modine Mfg. Co.

Circle No. **9** *on Reply Card*



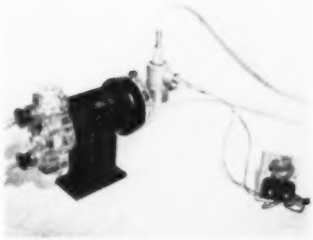
Steam Turbine Drive Now Available In Line of Standard Centrifugal Pumps

Steam turbine drive has been added to the Byron Jackson pump line in the form of a combination of the standard "TL Bilton" pump sizes with one of two "Moon" steam turbines. The two turbine sizes used both have the same shaft extension and rabbit fit so that one standard TL Bilton connector and shaft sleeve is used with all pump and turbine combinations. The close-coupled unit has small space requirements and needs no rigid foundation. It can be mounted at any angle (including wall mounting). Pump sizes are $1\frac{1}{4}$ to 3 in.; capacities up to 600 gpm.; heads to 320 ft. The unit is also available to special construction, including a mechanical seal. Byron Jackson Co.

Circle No. **10** *on Reply Card*

Adjustable 50 psig. Feeding Pump Has Top Capacity of 2 cc./stroke

A new, small model with maximum capacity of 2 cc./stroke has been added to the Proportioneers' line of diaphragm pumps with the so-called "See-Thru" plastic reagent heads. The "Pee-Wee," or midget "Chem-O-Shot" pump provides for continuous



or intermittent feeding of water treating chemical solutions and slurries against pressures up to 50 psig. Model E is an electrically-actuated unit and Model H is hydraulically-actuated. Both are positive displacement, diaphragm type. Pump stroke length is adjustable over the entire range while the unit is in operation. Proportioneers, Inc.

Circle No. **11** *on Reply Card*

DID YOU MISS THESE?

The following items, reviewed originally in the March "What's New!" have aroused considerable interest among readers. They are repeated briefly as a service to those who might have missed them. For details or copies of literature, use the reply card in this issue.

Displacement-Type Detector Provides Sensitive Control of Liquid Level

Precise and sensitive control of minute changes in liquid level is provided in a new displacement-type detector and force-balance transmitter using a bellows seal that can be hooked up with a standard receiver-controller and a diaphragm valve. It is recommended particularly for fractionator control where charge must be kept at uniform temperature. Instrument has ranges of 0-14 up to 0-120 in.; pressures, 300 and 600 psi.; is made in various required alloys for severe services. Minneapolis-Honeywell Regulator Co., Brown Industrial Div.

Circle No. **12** *on Reply Card*

"Six-in-One" Proportioning Pump Will Meter Liquids up to 500 cc./min.

The Brosites Model No. "0" proportioning pump is a combination of six separate pumps operated by a common, single phase, 1/20 hp., 110 volt, motor. Each pump has a capacity of 1 to 500 cc./min., when the solution is water or a free-flowing liquid. Total capacity of 3000 cc./min. can be obtained by operation in parallel. Flow can be regulated. Brosites Machine Co.

Circle No. **13** *on Reply Card*

Aviation Gasoline Processes

Heat Engineering, January, 1951, includes an eight-page article on catalytic processes and aviation gasoline: covering for example: isomerization; alkylation; and catalytic cracking, reforming, and aromatization. Foster Wheeler Corp.

Circle No. **14** *on Reply Card*

Refinery Valve Specifications

Nordstrom Valves, Specifications for Petroleum Refinery Services; stiff-cloth, ring-type binding, containing complete set of bulletins with full service conditions and specifications, diagrammatic flow charts, and concise descriptive information on 19 present-day important petroleum processes and their valve requirements. Rockwell Mfg. Co., Nordstrom Valve Div.

Circle No. **15** *on Reply Card*

Lightweight, Portable Meter Permits Rapid, on-the-spot pH Determinations

Instant, on-the-spot pH determinations can be obtained with a new portable, three-lb., meter and companion probe unit, completely self-contained with batteries, in a bakelite case 3 x 5⅞ x 2½ in. The instrument is furnished in a carrying case with hand and shoulder straps, and with plastic tubes of buffer and KCl solutions. Supports and beakers are eliminated by combining the calomel and glass electrodes with the sample holder in a single polyethylene probe unit. This patented idea protects these accessories and requires a sample volume of only 0.5 ml. The meter is scaled from 2 to 12 pH, with an adjustment for readings from 0 to 14. Accuracy is 0.1 pH. Batteries provide up to 1300 hrs. of operation, are of hearing-aid type. Electrometer tube, switch, and input connector are sealed in single unit to provide freedom from high humidity problems. Analytical Measurements, Inc.

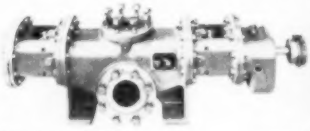
Circle No. **16** *on Reply Card*

100 psi. Strain Gage Pressure Cells Are Insensitive to Linear Acceleration

Four SR-4 pressure cells in capacities of 10, 20, 50, and 100 psi. have been redesigned to make them insensitive to linear acceleration and to position. Their operation is based on SR-4 resistance wire strain gage measurement with a four-arm Wheatstone bridge. Range extends from absolute vacuum to full rated pressure, except in standard units of lowest capacity for which the range is limited to ±10 psi. Cells meeting other requirements are made to order. Two types are offered: ES321 cells have all parts in contact with the pressure fluid of type 321 stainless steel. Type EMB have pressure bellows of Monel and brass pressure fittings leading to the bellows. Connections for each are through standard ⅛-in. male pipe thread. The cells are designed for standard 120-ohm circuit. Recommended input voltage is 5, but a maximum of 8 may be used. Open-circuit output is 2.000±0.005 millivolts per volt input to the bridge for capacity pressure. Cells are temperature compensated for zero and span. Calibration accuracy is within ¼% of full scale at any point within rated range. Maximum temperature for full accuracy in continuous operation is 150° F. Cells are enclosed in an aluminum box, 3¼ x 3¼ x 1⅝ in., with pressure inlet and electrical connections on opposite sides. Baldwin-Lima-Hamilton Corp.

Circle No. **17** *on Reply Card*

PUMP CRUDES, ASPHALT, DISTILLATES, WAXES?



The NEW Sier-Bath
External Gear & Bearing Bracket Type
SCREW PUMP

Capacities: 1-700 GPM
Discharge: 1000 PSI for viscous liquids
300 PSI for water

provides greater dependability, longer life . . . costs less to service and maintain

NEW FEATURES:

Single-point Alignment. Just one support point—base of pump body. External housings bolted directly to pump body, thus eliminating bearing strain and rotor misalignment due to change of position of pump elements.

"Dual-controlled" Rotors for less wear on bearings and timing gears. *Axial* control by heavy-duty thrust bearings—*radial* control by precision cut timing gears and heavy-duty roller bearings.

Faster Servicing—gear housings center line supported, doweled for accurate alignment. All parts automatically positioned by shoulders and locknuts.

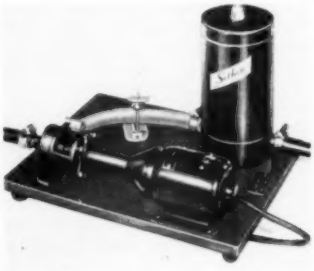
ADDITIONAL ADVANTAGES:

Less Strain on Valves and Piping — pulseless discharge, no hammer or vibration.
No Metallic Contact Between Rotors sustains high volumetric efficiency.
High Volumetric Efficiency reduces wear caused by erosion.
Only Suction Pressure on Stuffing Boxes reduces packing maintenance.
Direct-connected up to 1800 RPM.

Available in corrosion resistant alloys. Special bodies, stuffing boxes and bearings for high temperature applications. Hopper type bodies for extremely high viscosities. Sier-Bath "Gearex" Pumps for lower pressures and capacities.

Sier-Bath
GEAR and PUMP CO., Inc.

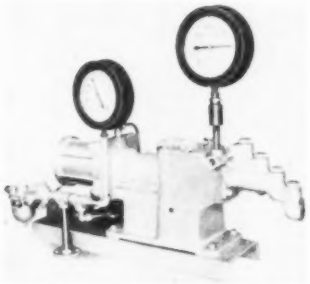
WRITE FOR FURTHER INFORMATION
9271 HUDSON BLVD.
NORTH BERGEN, N. J.
Also Manufacturers of Precision Gears and Flexible Gear Couplings



Small Filtering Unit Uses Plastics And Alloys for Corrosion Resistance

High resistance to all acids and alkalis and many industrial solvents, including chlorinated aromatic compounds, and at temperatures up to 265 F. is provided in a new "Sethco" laboratory size filter pump unit, the Model HHUE-5, with a capacity up to 50 gal./hr. Chemical resistance is made possible by the filter cylinder of asbestos impregnated with furfuryl alcohol resin and the pump and fittings of Hastelloy. The filter element proper is a processed cotton yarn wound around a stainless steel supporting core. Porous stone and porous carbon filter tubes are furnished for handling concentrated acid and alkali solutions respectively. Tubes may be used repetitively. Sethco.

Circle No. **18** *on Reply Card*



Hydrostatic Test Pump Provides for Wide Pressure Range to 25,000 psi.

The "aiROYmetric" Pressure Generator will develop hydrostatic test pressures up to 25,000 psi. using normal plant air supply in the pump cylinder. It has use in testing boilers, tubing, pipe and piping systems, gages, valves, castings, high pressure hose, and many others. It can be used for filling liquefied gases into containers, or can serve as a booster for maintaining required hydraulic system pressures. Capacities range from 4 to 405 gph; pressures from 25 to 25,000 psi. Each of the multiple reciprocating pumps develops a discharge pressure ratio range of at least 6 to 1, permitting single pump use for applications requiring various test pressures. Milton Roy Co.

Circle No. **19** *on Reply Card*

Angle Design in Duplex Strainer Gives High Flow Rate, Low Pressure Drop

High flow rates with very low pressure drop between inlet and outlet in a new Gate Type Duplex Strainer are obtained by an angle design applied to multiple catch-baskets which permits straight-through flow. When the baskets are 90% blocked, pressure drop increases 40%, as measured with water at room temperature. Strainers are fitted with hinged top covers and multiple baskets to allow cleaning by one man. Operating screw is fully sealed from fluids inside the strainer, and is armored over its whole surface by a heavy housing so it cannot be damaged by corrosion, dirt, or physical accident. Free-floating bronze valve discs insure against binding and are removable easily through access covers. These discs act against replaceable bronze seats. At the user's option, the strainers may be furnished for right or left hand operation, and with chain drives to operate inlet and outlet valves simultaneously, permitting continuous flow. Another optional feature is a by-pass valve, recommended when high fluid pressures provoke difficult handwheel operation. The strainers are available in 8, 10, 12, 14, 16, 20, and 24 inch sizes, to handle flow rates from 400 to 15,000 gpm. J. A. Zurn Mfg. Co.

Circle No. **20** *on Reply Card*

Air-drive Valve Seat Grinder Handles Large Engine Seat Diameters to 12 in.

A new portable air-driven valve seat grinder has been developed especially for large internal combustion engines with inside seat diameters from 2 15/16 to 12 in. It can be used for grinding both seat faces and counterbores within the size range, and regularly holds concentricity to 0.003 in. It is said to accomplish in a few minutes what might normally require hours by ordinary reaming and hand lapping methods. The tool

CHIKSAN MARINE & BARGE HOSE

LIGHT WEIGHT • EASY TO HANDLE

With the **CHIKSAN** aluminum Marine & Barge Hose, dock-to-vessel connections can be made by one man in just a few minutes. When not in service, the hose easily and quickly folds into a compact unit, without requiring disconnection from the Dock Riser. The same hose can be used for both suction and discharge.

MANY EXCLUSIVE ADVANTAGES

The **CHIKSAN** Hose, when used as shown, saves time, labor and expense, as well as dock space, and permits free movement of other equipment.

CHIKSAN Marine & Barge Hose, being made of metal, is not affected by severe climatic conditions or by petroleum products which may cause other hose to deteriorate rapidly. For the same reason, this all-metal hose is not subject to kinking, crushing or cutting—thus outlasting other hose.

CHIKSAN Marine & Barge Hose can be supplied in any required length and size, with end connections as specified, in either aluminum or steel, for above-surface or underwater service.

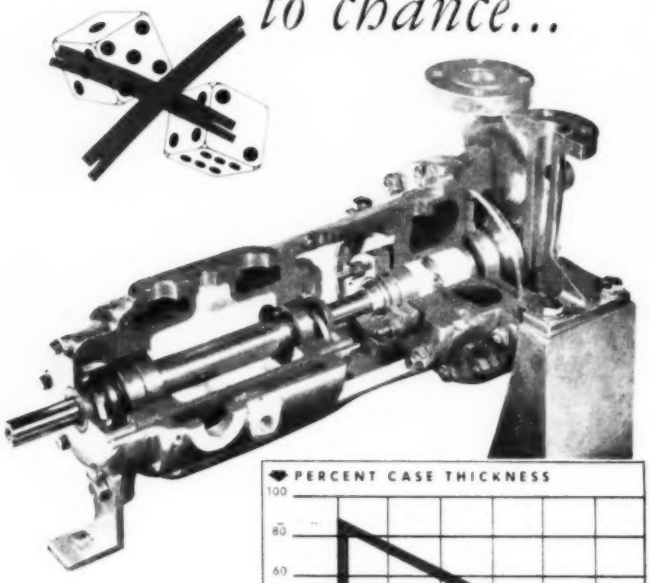
CHIKSAN TRADE MARK REG.

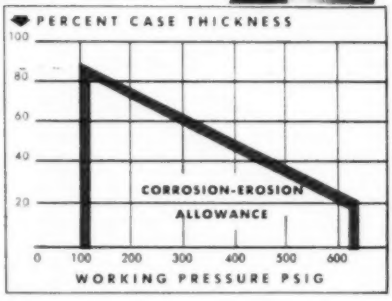
CHIKSAN COMPANY
AND SUBSIDIARY COMPANIES
Chicago 3, Ill. BREA, CALIFORNIA Newark 2, N. J.
WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
CHIKSAN EXPORT CO. BREA, CALIFORNIA NEWARK 2, N. J.

WRITE FOR COMPLETE CHIKSAN CATALOG

REPRESENTATIVES IN PRINCIPAL CITIES
SOLD BY LEADING SUPPLY STORES EVERYWHERE

Nothing is left to chance...





when you specify

Pacific *Precision Built*

HEAVY DUTY PROCESS PUMPS

. . . pumps that are custom built to provide a more-than-adequate margin for safe operation even where high pressure, extreme temperature and corrosion, may all be predominant factors. The chart illustrates graphically the margin of safety that Pacific builds into Process Pumps. For example: Chart above for a large pump shows that at 625 PSIG working pressure and 800° F. temperature a 20% margin of safety is provided; at 300 PSIG a 61% margin of safety is provided at the same temperature. Other readings are clearly indicated. Thus your choice is proved sound before your okay to purchase a Pacific Process Pump appears on the specifications.

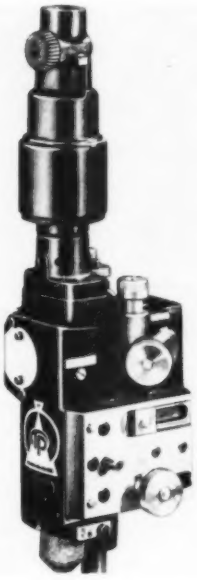
Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES
HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

PACIFIC *Precision Built* PUMPS

PR 11

What's New!



consists essentially of a grinding unit with easily accessible controls, a wheel dressing unit, and an air motor. The grinder is driven at 10 rpm. around a pilot centered in the valve guide, with the grinding wheel operating at 12,000 rpm. Only a small portion of the wheel contacts the seat surface, eliminating egg-shaped seats, chatter, and downtime for wheel dressing. Grinding unit housing and wheel dressing unit are of cast iron to absorb vibration. Wheels can be dressed without removing grinder from the pilot. A diamond tool performs the dressing operation, and any angle from 0 to 90 can be obtained. The unit uses air pressure from 90 to 125 psi, with a high volume tank recommended. Thompson Products, Inc.

Circle No. **21** *on Reply Card*

Trade Literature

Stainless Chromium Steels

The Properties and Methods of Working Seamless and Welded Tubes and Pipe of the B & W Stainless Croloys, Technical Bulletin 1B; 104-page, leather-bound booklet in pocket-size, 5 x 8 in., designed as a guide for engineers, designers, and fabricators in the selection of proper material and in planning the conversion of the tubing into finished products. Babcock & Wilcox Tube Co.

Circle No. **22** *on Reply Card*

What's New!

Piping Maintenance Hints

Piping Pointers, Helpful Hints on the Application and Maintenance of Piping Equipment, 36-page manual in "how-to-do-it" form, non-technical language, illustrating and discussing various types of valve designs and how they are used; includes a Valve Selection Guide. Company also has available through its branches and wholesalers a Piping Pointers film, 16mm., 30 minutes, in sound. Crane Co.

Circle No. **23** *on Reply Card*

Largest Two-Stage Crude Still

Heat Engineering, April, 1951, includes a seven-page article describing one of world's largest two-stage crude stills, a 63,000 b/d design capacity unit which went on stream recently at the Amuay Bay, Venezuela, refinery of the Creole Petroleum Corp. Foster Wheeler Corp.

Circle No. **24** *on Reply Card*

New Process Heater Design

Selas Gradiation Heater for the Petroleum Refining Industry, Bulletin S-6.2; 16 pages describing the use of radiant gas heat in tubular heaters for petroleum processing; explaining the principle of design which distributes radiant heat uniformly around and along the tubes. Selas Corp. of America.

Circle No. **25** *on Reply Card*

Temperature Regulators

Mercury Actuated Thermo-Regulators and Thermostats, Catalog 18; 12 pages of technical information on line of temperature equipment with accuracy requirements ranging from ±0.005 to ±0.10° C., and range extremities of −35 to +350° F. H-B Instrument Co.

Circle No. **26** *on Reply Card*

Automatic Distillation

Precisionomics, Vol. 3, No. 1, contains data on a new automatic distillation apparatus designed for the petroleum and other industries where routine distillations can be tedious and expensive. Precision Scientific Co.

Circle No. **27** *on Reply Card*

Large Induction Motors

Large Induction Motors, Booklet B-4739; a 28-page booklet giving engineering details and suggested applications for the two basic types of induction motors offered. Type CSF squirrel-cage motors for constant

keeping jobs AHEAD OF SCHEDULE is easy with AIRETOOL

Even your least experienced operator can finish rolling a tough tube bundle way ahead of schedule. Refineries now using this new AIRETOOL tube rolling control save valuable hours every time it is put in service.

It's simple to operate. Just insert the ball bearing type expander in the tube to be rolled and when it is perfectly expanded the control automatically shuts off the motor. Expansion guesswork has been eliminated.

CONTROL OFFERS EXCLUSIVE ADVANTAGES
- Permanent calibration... needs no adjustment.
- Chatter-free relay operation.
- No delicate electronic tubes used.
- Minimum number of moving parts to wear out.

Get your own tube rolling jobs running ahead of schedule. Find out immediately how this control can help. Write the AIRETOOL MFG. CO., 336 S. Center Street, Springfield, Ohio.

FURNACE TYPE CLEANER

This AIRETOOL Furnace type cleaner with ball-bearing motor and three tier cutter head is just one of our many "timesavers."

No. 939

SEE OUR CATALOG IN REFINERY CATALOG

AIRETOOL MANUFACTURING COMPANY

SPRINGFIELD, OHIO

Branch Offices: New York, Philadelphia, Tulsa, Chicago, Houston, Baton Rouge.

There's an AIRETOOL Tube Cleaner and Tube Expander for every Type of Tubular Construction.

speed drive, and Type CWF woundrotor motors for adjustable speed drive, in a variety of enclosures. Westinghouse Electric Corp.

Circle No. **28** *on Reply Card*

Fatty Acid Chemicals

Emery 955 Dimer Acid, a 16-page booklet covering this dilinoleic acid which has been established as a full-scale commercial product, its specifications and characteristics, shipping and handling, and its applications; including uses in greases, soaps, insecticides, emulsion breaking, and surface coatings. Emery Industries, Inc.

Circle No. **29** *on Reply Card*

How to Care for Industrial Rubber

Conservation Maintenance Plan includes a handbook, wall charts, and monthly bulletins on selection, installation, and proper maintenance of industrial rubber hose, packing, and belting. Quaker Rubber Corp.

Circle No. **30** *on Reply Card*

Gasoline Plant Instrumentation

Instrumentation, Vol. 5, No. 2; includes a four-page article on the instrumentation of McCarthy Chemical Co.'s natural gasoline plant at Winnie, Texas. Minneapolis-Honeywell Regulator Co., Brown Instruments.

Circle No. **31** *on Reply Card*

Film Type Heat Exchangers

Vogt Film Type Heat Exchangers, Bulletin HE-7; covers design and applications for film type heat transfer equipment which permits use of dirty cooling water; sizes available cover range from 10,000 to 20,000,000 Btu/hr. Henry Vogt Machine Co.

Circle No. **32** *on Reply Card*

Cleaning Unit for Compressed Air

Selas Vape-Sorber, Bulletin SC-10 X3; four pages describing a unit for the continuous removal of petroleum vapor, water, free oil, water-oil emulsions, and dirt from compressed air and other gases, utilizing liquid-impervious ceramic filters in conjunction with activated carbon. Selas Corp. of America.

Circle No. **33** *on Reply Card*

Gaskets and Packing Materials

RM Packings and Gaskets; a 100-page, loose-leaf, leatherette cover, catalog with complete technical information on company's entire line of packing and gaskets; including eight pages of helpful engineering data. Raybestos-Manhattan, Inc.

Circle No. **34** *on Reply Card*

Power Operated Plug Valves

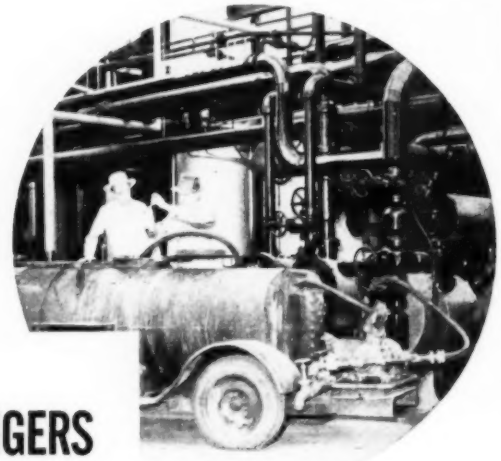
Power Operated Nordstrom Valves, Bulletin V-214; 40-page manual covering piping, wiring, mounting, and installation data for pneumatic-hydraulic, and electric operated lubricated plug valves, including typical piping diagrams, arrangements for side and top mounted motor controls, closing speeds, wiring data, and installation pictures. Rockwell Mfg. Co.

Circle No. **35** *on Reply Card*

Stainless Steel Tubing Data

B&W Stainless Croloy Tubing Steels, Bulletin TB-19; condensed technical data on analyses, oxidation resistance, thermal treatment and mechanical, electrical, and physical properties on ten popular austenitic and ferritic stainless tubing steels, seamless and welded. Babcock & Wilcox Tube Co.

Circle No. **36** *on Reply Card*



HEAT EXCHANGERS

cleaned chemically cuts out-of-service time

THE *quickest* and (in the long run) *cheapest* way to clean tubular heat exchangers is the *in-place* method of circulating hot solutions of chemical cleaning compounds. Much quicker, more thorough than lancing with air or steam. No danger of damage to metal surfaces as with rodding, drilling, or fish-sawing.

For the complete Oakite story on cleaning and descaling exchangers, other equipment, write nearest address below. Interesting literature—personal in-plant services freely available to you without obligation. Send today to Oakite Products, Inc., 44C Thames Street, New York 6, N. Y.

SEND for this FREE Booklet. It is full of useful information on general maintenance cleaning. Covers all divisions of the Petroleum Industry—production, processing, transportation, marketing.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE

PETROLEUM SERVICE DIVISION

(*To obtain more data on advertised products see page* 548)

Instrument Panels

Instrument Panelboards, Bulletin 143; four-page folder on a line of instrument control center panels, console cabinets, cubicles, and wiring; in mild and stainless steels, aluminum, and alloy metals up to ¼-in. plate. Falstrom Co.

Circle No. **37** *on Reply Card*

Unions, Thread Compounds, etc.

Weco, Catalog 51; 28 pages on 1000 to 15,000-lb. test unions, thread compounds, boiler accessories, etc. Well Equipment Mfg. Corp.

Circle No. **38** *on Reply Card*

Material Handling Equipment

Yale Materials Handling Equipment, a 44-page comprehensive catalog on gas and electric fork lift trucks, motorized hand trucks, hand lift trucks, and hand and electric hoists. Yale & Towne Mfg. Co.

Circle No. **39** *on Reply Card*

Uses for Cast Monel

Uses Broaden for Cast Monel, reprint of an 8-page article from *Iron Age,* including charts on corrosion resistance, mechanical and physical properties, and chemical composition of different types of the alloy. Cooper Alloy Foundry Co.

Circle No. **40** *on Reply Card*

Corrosion-proof Pumps, Exchangers

Nu-Kast Pumps, Heat Exchangers and Floor Drains; four-page folder on non-metallic, cast resin, acid and alkali-proof pumps in capacities to 100 gpm., exchangers in various sizes. Nukem Products Corp.

Circle No. **41** *on Reply Card*

Expansion Joints

Expansion Joints and Flexible Connectors, Bulletin 351; a four-page bulletin with sizes, dimensions, suggested applications, and other technical data. Zallea Brothers.

Circle No. **42** *on Reply Card*

Coatings for Aluminum

Alodizing with Alodine Protects Aluminum and Its Alloys, Form 586B; four pages describing a method for treating aluminum surfaces with amorphous phosphate coatings to improve paint bonding and protect the metal in general. American Chemical Paint Co.

Circle No. **43** *on Reply Card*

Synchronous Motor Controls

E-M Polarized Field Frequency Controls for Synchronous Motors, Bulletin 3100-PRD-204; eight pages describing these controls (standard interrupting capacity type) for full-voltage, reduced-voltage, and part-winding starting; with ratings, weights, dimension drawings, wiring diagrams, layout drawings, and specifications for each type of control. Electric Machinery Mfg. Co.

Circle No. **44** *on Reply Card*

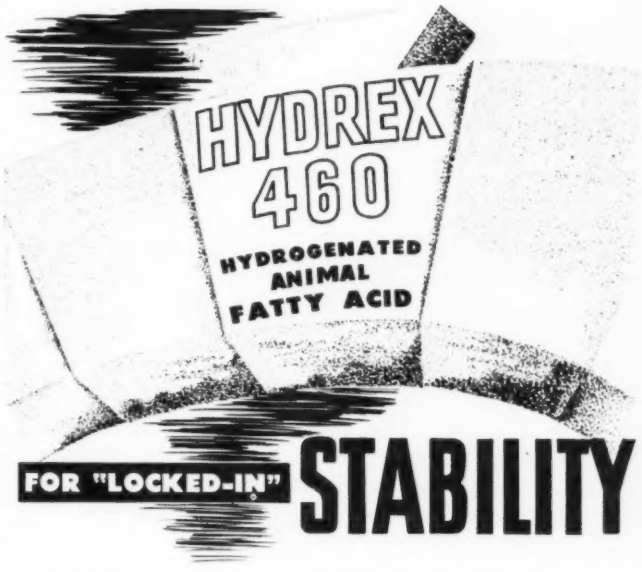
Hose, Packing, Belting

Engineered Rubber Products for the Oil Refining Industry, 20-page catalog covering flat and Vee-belts; hose for acids, air, ammonia, LPG, gasoline, steam and water, oil; gaskets and packing for LPG, gasoline, filter presses; expansion joints; and plastic pipe and fittings. United States Rubber Co.

Circle No. **45** *on Reply Card*

Viscosity Control Instruments

Viscorator Instruments, Catalog 88; 12 pages on an instantaneous method for determining viscosity, featuring an automatic sampling de-



Our hydrogenation process makes it possible in regular production runs to reduce the proportion of unsaturated compounds to a minimum . . . greatly improving the stability of the fatty acid *and the end product.*

For example, Hydrex 460 Hydrogenated Animal Fatty Acid is a water-white, stable, saturated fatty acid that is relatively rich in stearic acid (about 70.0%), with about 30% palmitic acid and practically free of oleic acid. Yes, with our hydrogenation technique we are producing high melting point, low iodine value fatty acids with controlled composition. Manufacturers of fatty acid esters, metallic stearates, special lubricants and other products where *stability* is essential, should investigate medium-priced Hydrex 460 Hydrogenated Animal Fatty Acid.

W. C. HARDESTY CO., INC. — HARDESTY PRODUCTS SET INDUSTRY'S STANDARDS — ESTABLISHED 1926 — 51 EAST 42nd STREET, NEW YORK 17, N.Y.

HYDREX 460 SPECIFICATIONS

Titre	(134.6-140.0°F) 57.0 - 60.0°C
Color 5¼" Lovibond Column (max)	4 Yellow - 0.4 Red
Iodine Value (Wijs)	1 - 4
Free Fatty Acid (as oleic)	100 - 103%
Acid Number	199 - 205
Saponification Value	201 - 207

FACTORIES DOVER, OHIO TORONTO, CAN.

(To obtain more data on advertised products see page 548)

vice with a constant differential pressure regulator as an integral part of its design, providing constant meter sample flow rate. Fischer & Porter Co.

Circle No. **46** *on Reply Card*

General Purpose Centrifugal Pumps

Peerless Fluidyne Pumps, Bulletin B-2300; 24 pages of catalog data on a broad line of horizontal, end-suction, centrifugal pumps in capacities from 10 to 5500 gpm., heads to 260 ft., and may be driven by electric motors from ¼ to 150 hp. Peerless Pump Div., Food Machinery Corp.

Circle No. **47** *on Reply Card*

Stainless Steels

Armco Precipitation - Hardening Stainless Steels, 16-page booklet describing properties, available forms, and fabrication of 17-4 PH and 17-7 PH stainless steels; including complete technical data. Armco Steel Corp.

Circle No. **48** *on Reply Card*

Radioactivity Safety

How Safe? Radiation Monitoring for Civil and Industrial Safety, 16-page booklet explaining radioactivity and means for detecting and handling it; including catalog information on special instruments. Tracerlab.

Circle No. **49** *on Reply Card*

Sulfur Recovery Plant

Heat Engineering, March, 1951, contains a three-page article describing the one-year-old, 300 ton/day plant of Texas Gulf Sulphur Co. at Worland, Wyo., for recovering sulfur from sour natural gas. Foster Wheeler Corp.

Circle No. **50** *on Reply Card*

Needle Valves for Corrosive Service

Kerotest Needle Valves, Bulletin No. 51-N; describes forged steel carbon or stainless union bonnet needle valves for corrosive service for working pressures to 4000 psi. at 150° F. in sizes ⅛, ¼, ⅜, ½, and ¾ in., globe and angle types; including price list. Kerotest Mfg. Co.

Circle No. **51** *on Reply Card*

Three Types of Floating Roof Tanks

Hammond Floating Roof Tanks, Bulletin 51F; eight pages of technical information on double deck, pontoon design, and pan floating roof types of petroleum storage tanks designed for product conservation and corrosion prevention. Hammond Iron Works.

Circle No. **52** *on Reply Card*

Welding of Copper Alloys

Aircomatic Welding of Copper-Base Alloys; Form ADR 69; a reprint of an 18-page article from the *Welding Journal* on this type of welding by the use of inert-gas-shielded, metal-arc processes. Air Reduction Co., Inc.

Circle No. **53** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

If you want . . .

INCREASED THROUGHPUT

from existing processing equipment

Get the facts on . . .

METEX MIST ELIMINATORS

In plant after plant, these knitted-wire mesh units, by removing *more than* 95% of the entrained liquids, are enabling petroleum refiners to

. . . CUT PROCESSING COSTS

. . . MAINTAIN PRODUCT QUALITY

. . . AND INCREASE OUTPUT

Furnished in sections, and cut to fit the dimensions and shapes of towers and stills, Metex Mist Eliminators can be easily installed in existing equipment. Their effectiveness also leads to further economies on new construction.

For detailed information on this modern method of coalescing and removing liquids entrained in the vapor in vacuum pipe stills, scrubbing towers, knockout drums, evaporators and similar equipment, write for your copy of our 8-page bulletin — "Metex Mist Eliminators".

METAL TEXTILE CORPORATION

631 EAST FIRST AVENUE, ROSELLE, N. J.

Metal Textile Corporation
631 East First Avenue, Roselle, N. J.

Gentlemen:

I'd like to have a copy of "Metex Mist Eliminators".

Name _____ Title _____

Company _____

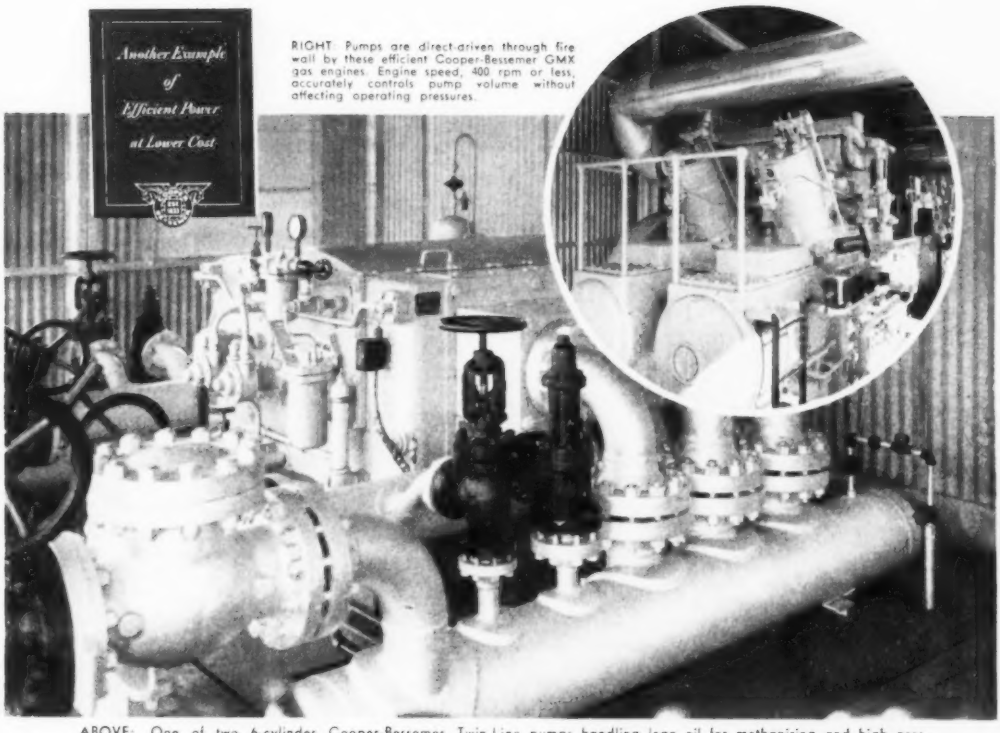
Address _____

City _____ State _____

(*To obtain more data on advertised products see page* 548)

Another Example of Efficient Power at Lower Cost

RIGHT: Pumps are direct-driven through fire wall by these efficient Cooper-Bessemer GMX gas engines. Engine speed, 400 rpm or less, accurately controls pump volume without affecting operating pressures.



ABOVE: One of two 6-cylinder Cooper-Bessemer Twin-Line pumps handling lean oil for methanizing and high pressure absorbing at Sun Oil's Starr County Gasoline Plant.

Starring in **LOW-COST DOUBLE DUTY** ... at Sun Oil's Starr County Gasoline Plant

Maybe you can pick up a money-saving idea from this unusual pumping operation. Here, Sun Oil wisely took advantage of the flexibility of Cooper-Bessemer Twin-Line pumps to deliver lean oil at two different pressures simultaneously . . . for methanizing and for high pressure absorbing.

Because Twin-Line pumps have two banks of opposed cylinders, because they permit extreme flexibility and hold high efficiencies despite wide variations in demand, they are performing this double service with exceptional economy.

The pump shown opposite is one of two now in Sun Oil's service. The high pressure side of each delivers 248 gpm at 1100 psi. The low pressure side, or first stage, has a capacity of 388 gpm at 225 psi, the excess going to the low pressure demanthanizer. Each pump is direct-driven by a Cooper-Bessemer GMX gas engine at 400 rpm, or less, eliminating all need for gearing. Volumes are accurately controlled by varying engine speeds without affecting the operating pressures.

With prolonged 92% mechanical efficiencies and 96% volumetric efficiencies, these units are maintaining operating economy seldom equalled.

The extreme flexibility and simplified drive, of Cooper-Bessemer Twin-Line pumps make them suitable for a broad range of services. Maybe they can save you important money. Simply check with the nearest Cooper-Bessemer office.

The **Cooper-Bessemer** *Corporation*

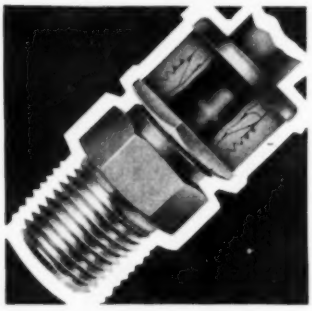
MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York, N. Y. Washington, D. C. Bradford, Penna. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greagton, Pampa and
Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La.
St. Louis, Mo. Los Angeles, Calif. Chicago, Illinois Caracas, Venezuela

SWITCH TO

Swagelok*

TUBE FITTINGS



Bothersome small leaks in instrumentation lines, the frequent cause of processing shut-downs, are avoided with the installation of Swagelok fittings. They form a leakproof seal with one and one quarter turns. No torque is transmitted to the tubing in assembly. Swagelok fittings are made in all popular sizes and will hold heavy or thin wall tubing equally well.

FREE—For complete details and descriptive literature write Dept. AP

* Patented

CRAWFORD FITTING CO.

884 E. 140th Street, Cleveland 10, Ohio

SWAGELOK FITTINGS AVAILABLE IN: BRASS, ALUMINUM, STEEL, STAINLESS STEEL, MONEL

COME TO YOU COMPLETELY ASSEMBLED, FINGER TIGHT

Literature Offered in this Issue's Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature offered in this month's advertisements:

ACTIVATED ALUMINA: Aluminum Co. of America. See adv't. p. 458.
CIRCLE NO. **K8** *ON REPLY CARD*

ADDITIVES: Free samples of phenyl-alpha-naphthylamine: The du Pont Co. See adv't. p. 522.
CIRCLE NO. **K9** *ON REPLY CARD*

ADDITIVES, Gasoline anti-oxidants Nos. 5, 6, and 22; Serial A-513: The du Pont Co. See advt. facing pp. 532-533.
CIRCLE NO. **L1** *ON REPLY CARD*

ANTI-KNOCK PERFORMANCE OF MOTOR FUELS: Serial A-505. The du Pont Co. See adv't facing pp. 532-533.
CIRCLE NO. **L2** *ON REPLY CARD*

CATALYST SUPPORTS: Experimental samples: Norton Co. See advt. p. 541.
CIRCLE NO. **L3** *ON REPLY CARD*

COOLING TOWER FANS: Hartzell Propeller Fan Co. See adv't. p. 457.
CIRCLE NO. **L4** *ON REPLY CARD*

CORROSION INHIBITOR: Technical information on use of Santolene C: Monsanto Chemical Co. See adv't. p. 461.
CIRCLE NO. **L5** *ON REPLY CARD*

EXPANSION JOINTS: 24-page catalog: Badger Mfg. Co. See adv't p. 527.
CIRCLE NO. **L6** *ON REPLY CARD*

EXPANSION JOINTS: Catalog No. 212: United States Gasket Co. See adv't. p. 532.
CIRCLE NO. **L7** *ON REPLY CARD*

FIRE-FIGHTING FOAM: Reference booklet entitled "Pyrene Air Foam Equipment." Pyrene Mfg. Co. See adv't p. 529.
CIRCLE NO. **L8** *ON REPLY CARD*

FITTINGS for pressure vessels: nozzles, necks, flanges: Pressure Vessel Catalog 501. Taylor Forge & Pipe Works. See adv't. p. 563.
CIRCLE NO. **L9** *ON REPLY CARD*

FLOW METERS, wet gas: Bulletin 7-110: Precision Scientific Co. See adv't. p. 481.
CIRCLE NO. **M1** *ON REPLY CARD*

HEAT EXCHANGERS: Bulletin HE-7: Henry Vogt Machine Co. See adv't. p. 544.
CIRCLE NO. **M2** *ON REPLY CARD*

HEAT EXCHANGERS, cleaning: Booklet: Oakite Products, Inc. See adv't. p. 556.
CIRCLE NO. **M3** *ON REPLY CARD*

HEATERS: 16-page book: Selas Corp. of America. See adv't. p. 471.
CIRCLE NO. **M4** *ON REPLY CARD*

HOSE, aluminum for marine & barge use: Catalog: Chiksan Co. See adv't. p. 553.
CIRCLE NO. **M5** *ON REPLY CARD*

LABORATORY WARE: Bulletin 793: Norton Co. See adv't. p. 541.
CIRCLE NO. **M6** *ON REPLY CARD*

OXYGEN ANALYZERS: Bulletin 50-829: The Hays Corp. See adv't. p. 474.
CIRCLE NO. **M7** *ON REPLY CARD*

PAINT, aluminum: Bulletin 504: Metals Disintegrating Co., Inc. See adv't. p. 537.
CIRCLE NO. **M8** *ON REPLY CARD*

PAINT, rust preventive: Catalog: Rust-Oleum Corp. See adv't. p. 539.
CIRCLE NO. **M9** *ON REPLY CARD*

PRESSURE VESSELS, custom fabrication: Complete information: Black, Sivalls & Bryson, Inc. See adv't. p. 531.
CIRCLE NO. **N1** *ON REPLY CARD*

PUMPS, centrifugal: Bulletin B-1300: Peerless Pumps Division, Food Machinery & Chemical Corp. See adv't. p. 483.
CIRCLE NO. **N2** *ON REPLY CARD*

REFRACTORIES, porous alundum plates and tubes: Bulletin 140: Norton Co. See adv't. p. 541.
CIRCLE NO. **N3** *ON REPLY CARD*

REFRACTORY SHAPES: Bulletin 803: Norton Co. See adv't. p. 541.
CIRCLE NO. **N4** *ON REPLY CARD*

SERVICES TO THE PETROLEUM INDUSTRY: Serial 663: The du Pont Co. See adv't. facing pp. 532-533.
CIRCLE NO. **N5** *ON REPLY CARD*

STEAM TRAP FLOATS, high pressure: Bulletin 348: W. H. Nicholson & Co. See adv't. p. 535.
CIRCLE NO. **N6** *ON REPLY CARD*

STEAM TRAPS: Bulletin 1450: W. H. Nicholson & Co. See adv't. p. 535.
CIRCLE NO. **N7** *ON REPLY CARD*

STORAGE TANKS: Illustrated bulletin: Graver Tank & Mfg. Co., Inc. See adv't. p. 449.
CIRCLE NO. **N8** *ON REPLY CARD*

STORAGE TANKS, spherical: Bulletin F: Chicago Bridge & Iron Co. See adv't. p. 473.
CIRCLE NO. **N9** *ON REPLY CARD*

TANK CLEANING: Serial A-1134: The du Pont Co. See adv't. facing pp. 532-533.
CIRCLE NO. **P1** *ON REPLY CARD*

THERMOMETERS: Catalog: The Electric Auto-Lite Co. See adv't. p. 535.
CIRCLE NO. **P2** *ON REPLY CARD*

TUBE FITTINGS, instrument lines: descriptive literature: Crawford Fitting Co. See adv't. p. 560.
CIRCLE NO. **P3** *ON REPLY CARD*

TUBES, steel: General catalog: Globe Steel Tubes Co. See adv't. p. 467.
CIRCLE NO. **P4** *ON REPLY CARD*

VALVES, control: Bulletin: The Annin Co. See adv't. p. 528.
CIRCLE NO. **P5** *ON REPLY CARD*

VALVES, engine exhaust: Serial A-656a Pet: The du Pont Co. See adv't, facing pp. 532-533.
CIRCLE NO. **P6** *ON REPLY CARD*

VALVES, L.P. Gas: 1951 Catalog: Orbit Valve Co. See adv't. p. 472.
CIRCLE NO. **P7** *ON REPLY CARD*

VISCOMETERS: Bulletin 7-705: Precision Scientific Co. See adv't. p. 481.
CIRCLE NO. **P8** *ON REPLY CARD*

WATER SOFTENERS: Reprint of article on hot zeolite softening: Graver Water Conditioning Co. See adv't. p. 482.
CIRCLE NO. **P9** *ON REPLY CARD*

PERSONALS

Irving J. Staid has been appointed manager of Carter Oil Co.'s manufacturing department and **Herman G. Gunter** has been appointed assistant manager of the Manufacturing Department.

Mr. Staid

Mr. Staid graduated from the University of Alabama in 1938 with a degree in chemical and metallurgical engineering and immediately began work as a chemist in laboratories of the Esso Standard Oil Co. refinery at Everett, Mass.

Mr. Gunter

After extensive experience with Esso Standard, Staid joined Carter in 1945 as chief engineer of the Billings refinery and in 1946 was made assistant manager of the Company's Manufacturing Department.

Mr. Gunter graduated in engineering from Johns Hopkins University and joined the Jersey Standard organization in 1930 as an analyst in the chemistry laboratory of the Baltimore refinery. After service in several of the Jersey refineries, he came to Carter in 1947 at the time of the construction of the new Billings, Montana, plant and since its completion has been General Superintendent in charge of operations there.

* * *

The Hanlon Award, highest honor in the natural gasoline industry and one of the ranking awards of the entire petroleum industry, has been conferred today on **Walter J. Podbielniak,** President of Podbielniak, Inc., Chicago. The ceremony took place at the 30th annual convention of the Natural Gasoline Association of America being held in the Mayo Hotel, Tulsa, Okla.

The presentation was made by NGAA president **James E. Pew,** Sun Oil Company, Philadelphia. The citation read in part: "We are today recognizing the part which Dr. Podbielniak played in the early development of practical analytical apparatus and his continuous efforts through the years to improve its accuracy and efficiency until it has become the most valuable single tool in the analysis of gas and liquid hydrocarbons. The low temperature fractional analysis equipment familiarly known as the "Pod column" in practically every oil company plant and laboratory, is only one of the laboratory devices which he helped to develop or developed exclusively but the importance of its role in natural gasoline operations could not be overemphasized."

Dr. Podbielniak was born in Buffalo, N. Y. where he attended the public schools and obtained his degree in analytical chemistry in 1920. Following a year as chemist with National Aniline Co., in that city he became an instructor in chemistry at National Alliance Junior College, Cambridge, Pa. He received his PhD at the University of Michigan in chemical engineering in 1928. He engaged in research for the Phillips Petroleum Co., for a year before branching out for himself in the manufacture of low temperature analytical equipment.

* * *

Dr. Paul D. Foote, vice president of Gulf Oil Corp. in charge of research and development, has been presented with the Outstanding Achievement Medal Award of the University of Minnesota at Minneapolis. The honor is reserved for former students who have attained high eminence and distinction. It was conferred as part of the University's centennial observances during the dedication of new social science and liberal arts buildings.

Dr. Foote

Dr. Foote, who received his Ph. D. in physics from the University in 1917, has played a leading role in

Adams Moves up to Chairmanship at Phillips

K. S. Adams, (right), president of Phillips Petroleum Co. since 1938, has been elected chairman of the board and chief executive officer and chairman of the executive committee. The action was taken by the board of directors at a meeting held after the company's annual meeting of stockholders in Bartlesville, Okla. Upon recommendation of Mr. Adams, **Paul Endacott,** (left), was elected president. Mr. Endacott, as executive vice president and assistant to the president, has been the operating manager of the company and will continue in the same capacity as president.

Stanley Learned was elected executive vice president and assistant to the president. **W. W. Keeler,** formerly vice president of refining, was elected director, and vice president and assistant to the executive vice president.

C. C. Tate was appointed manager of the refining department. **J. E. Bogk** was appointed chairman of the operating committee.

developing the Gulf laboratories at Harmarville, Pa., into one of the nation's major industrial research centers.

Currently he is a member of the Ordnance Advisory Committee of the Research and Development Division, Department of the Army, and member of the Naval Ordnance Laboratory Advisory Board. During World War II he was consultant to both the Office of Scientific Research and Development and to the Research and Development Board. Subsequently he served as a member of the Industrial Advisory Group of the Atomic Energy Commission.

Previously Dr. Foote was a senior fellow of Mellon Institute; former president of the American Physical Society; former vice president of the Washington Academy of Sciences; lecturer, University of Pittsburgh; editor-in-chief of the Journal of the Optical Society of America and the Review of Scientific Instruments; and associate editor of the Journal of the Franklin Institute.

* * *

Following the death of **E. K. Anderson,** general manager of refineries for the Skelly Oil Co., Tulsa, Okla., the following reorganization of the manufacturing department has been made:

G. E. Canaday has been named first assistant to the vice president in charge of manufacturing and in that capacity has general supervision of refineries, gasoline plants, lube and grease plants, the Pawhuska Research Laboratory, and the Gas Contract and Measurement Department. His title will be manager of refineries and gasoline plants.

J. Y. Haslam will continue as chief engineer of the Manufacturing Department, and in addition will be responsible for all construction work. He is in charge of maintenance engineering in the refineries and gasoline plants. He is also responsible for engineering and construction pertaining to the gas gathering systems built by the Manufacturing Department for the Production Department.

H. H. Belew, acting as special assistant to the vice president in charge of manufacturing and assistant to the manager of refineries, will be responsible for all detailed matters pertaining to refining operations. Mr. Belew will be directly responsible in matters pertaining to the manufacture of products in volumes consistent with sales forecast by the Marketing Department. Additionally he will serve as chairman of the Research Coordinating Committee and the Pawhuska Research Laboratory.

L. C. Newton was placed in charge of safety and personnel for the entire Manufacturing Department with direct attention going to the refineries, lube and grease plants, and Pawhuska Research Laboratory. **G. D. Tidwell** will continue to supervise safety and personnel matters for the Natural Gasoline Department and Gas Contract and Measurement Department. He also has been placed in charge of automotive equipment and purchase of plant sites and rights-of-way for the Manufacturing Department. He will continue to do special assignment work for the Vice President in Charge of Manufacturing. **John A. Craig,** formerly chief engineer of the Gasoline and Gas Division, has been assigned the duties of Superintendent of Gasoline Plants.

* * *

Max Neuhaus and **L. P. Scoville** have been elected Vice Presidents of Jefferson Chemical Co., Inc.

Dr. Neuhaus and Mr. Scoville have been on Jefferson's staff since the company was organized. Dr. Neuhaus, who went to Jefferson as manager of its Technical and Research Department, had previously been with The Texas Company and Texaco Development Corporation since 1932. He was educated in chemistry and chemical engineering at Rice Institute in Houston, from which he received his B. S. in 1927, and at the Technische Hochschule in Berlin. He returned to this country to receive his Sc. D. in chemical engineering from Massachusetts Institute of Technology in 1933.

Dr. Neuhaus

Mr. Scoville

Mr. Scoville went to Jefferson in 1944 as chief engineer, and was subsequently promoted to manager of the Production Department. Prior to his service with Jefferson, he was senior engineer for The Texas Company, where he served for 12 years. He received his A. B. in physics from the University of Redlands in 1928, and did graduate work in chemistry and chemical engineering at the University of Oregon and California Institute of Technology, receiving his M. S. in chemical engineering from the latter in 1930.

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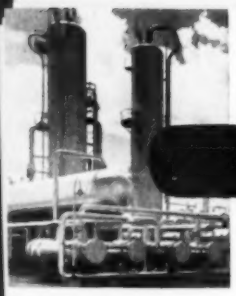

EDITORIAL VIEWPOINTS

Opinions and Comments on Current Topics

NGAA Promotes Analytical Accuracy

THE Natural Gasoline Assn. of America has thrown needed emphasis on a most important matter by its work on the accuracy of low-temperature fractional analysis. The subject is of as much interest to refinery management as it is to natural gasoline plants.

NGAA's work started when its fractional analysis committee decided two years ago to find out how accurately the memberships' laboratories could analyze commonly-encountered samples. At the 1950 convention a paper was presented showing how grievously the 59 laboratories cooperating had missed the mark and failed to agree with one another. But at the same time it confirmed that low-temperature fractional analysis methods are clearly capable of creditable accuracy. It concluded that "human elements" not evaluated in the tests probably were more responsible for the errors noted than inherent inadequacies in equipment or techniques.

As a result, NGAA sponsored a seminar on low-temperature fractional analysis in Ft. Worth March 15-16 which was attended by about 140 analysts representing 40-odd laboratories. Sessions were devoted to highly technical discussions aimed at improving analytical accuracy plus one session on management aspects.

Those attending were almost unanimous in supporting a request to NGAA directors for another seminar next year, to be held at some university. Here interested manufacturers of all types of gas and volatile liquid analysis equipment could have equipment set up, with sessions divided between technical discussions and actual operation of equipment under simulated laboratory conditions.

Meanwhile, a group from the American Society for Testing Materials reportedly has expressed interest in the work, providing discussions will be broadened to include analyses of hydrocarbons of special interest to refinery technicians. Such a cooperative effort should be mutually beneficial. Both groups have intimate dealings with each other and many of their laboratory problems are similar.

One of the interesting points brought out in the discussions, aside from possibly faulty techniques in individual laboratories and operator carelessness, is that individual job tenures generally are less than two years in the majority of laboratories represented and, not infrequently, less than a year. Consensus was that it requires up to two years to produce a highly competent operator. This may have no small bearing on why more accurate results were not obtained during NGAA's cooperative test program.

It was pointed out, however, that short job tenure in part stems from individual company practices of using the laboratory as a training ground for more responsible positions. Nevertheless, it was emphasized that too often the work is allowed to become so boring and pay rates frequently are such that men quit to secure less humdrum or more remunerative employment providing greater possibilities for future advancement.

Hence it appears that management may be overlooking the benefits to be obtained from adequate and informed supervision of their analytical staffs. A review of individual company policies as to rates of pay and possibilities for advancement may be long overdue. Consideration of the work required in its relation to maintaining high employe morale and reasonable working conditions should not be lost sight of, although it is unnecessary to provide a "country club" atmosphere.

The NGAA is to be congratulated for its efforts.

"Small" Refiners Participation Vital

THE attitude of Interior Secretary Chapman and others in Washington in challenging the 5-year tax write off on new defense facilities as provided in the 1950 Revenue Act, as applied to oil company refinery expansion, shows a lack of understanding of the fundamental problem of the oil industry in the mobilization program, and how it is proposed to meet it.

The imperative need at present is not so much for the building of many plants to make exclusively products for military use, as at the start of the last war, as it is to expand the industry's basic refining capacity. As PAD Deputy Administrator Bruce Brown has emphasized, we need to install 1,000,000 b/d of additional refining capacity in the U. S. by the end of 1953. Failure to accomplish this, he brings out, will mean the inability of the oil companies to fully meet general product demand. This would bring about a dislocation of our mobilization economy, which depends to such a great extent on the use in large volume of various products.

The importance of keeping up with essential civilian product demand was not generally recognized at the start of World War II. Conditions were such also that the principal effort of the industry was necessarily on new types of processing units to supply synthetic rubber materials and aviation gasoline. However, the failure of the industry to expand basic refining capacity began to make itself felt by the end of the war, even under civilian rationing, and it would have become serious had the war continued.

Our present mobilization effort may continue and grow for possibly as long as 10 years, some authorities state. In this period plants to make exclusively military products must be built, and logically with government money. If at the same time, however, basic capacity for processing crude in U. S. is allowed to lag, the crippling effect on our general mobilization program could be very great.

The 5-year depreciation tax write off on approved projects appears to offer the best means for supplementing private enterprise in refinery construction with government aid, and likely at as low a cost to the taxpayers as any other form of government aid. A good proportion of the projects PAD has thus far approved are among the smaller and so-called independent refining companies. This program, by its very nature, encourages the participation in the plant expansion program of the smaller companies. It also provides for maintaining the competition of these companies with the major interests. Both these considerations for business in general have been very dear to the espoused program of the Truman administration. The PAD program would seem something that Washington would endorse rather than obstruct.

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